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Technology transfer clearing house and international information network

Proposal for activities

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I. INTRODUCTION

A. Mandate

1. The need to enhance the access of developing countries, within the UNFCCC process, to information on state-of-the-art environmentally sound technologies (ESTs) has been recognized since the first Conference of the Parties (COP). Decision 13/CP.1[1] on the transfer of technology requested the Convention secretariat "to prepare an inventory and assessment of environmentally sound and economically viable technologies and know-how conducive to mitigating and adapting to climate change. This inventory should also include an elaboration of the terms under which transfers of such technologies and know-how could take place".

2. In decision 7/CP.2,[2] paragraph (e), the COP further requested the Convention secretariat "to initiate action, including consultations with Parties and relevant international organizations, inter alia, taking into account the ongoing work of the Climate Technology Initiative, to identify existing technology information activities and needs, with a view to developing options for building on existing specialized information centres and networks to provide fast one-stop databases relating to state-of-the-art, environmentally sound and economically feasible technology and know-how in a manner that would be readily accessible to developing countries. The options should consider the need and resources required for improving existing, and setting up additional, technology information centres and networks."

3. By its decision 9/CP.3, paragraph 2(b), the COP also requested the secretariat to consult with the Global Environment Facility (GEF) and other relevant international organizations, "on their capabilities and abilities to support the work of (an) international technology information centre(s), as well as national and regional centres, and to enhance the support for national and regional centres and to report to the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI) on its findings".[3]

4. Since then, issues relating to an information clearing house on technology transfer and technology information centres and networks have been considered at various subsequent sessions of the COP and the SBSTA. More recently, at the first part of its thirteenth session, the issues were reiterated and the SBSTA "expressed appreciation to the secretariat for the information it had provided on a preliminary framework for a technology information system. It requested the secretariat to further elaborate the proposal for activities in this area at the second part of its thirteenth session, taking into account (i) the resource implications of continuing this work at different levels of efforts and (ii) the discussions held on this proposal".[4]

5. At its fourteenth session, the SBSTA took note of the progress made by the secretariat in developing a technology information system, and invited interested Parties to contact the

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[1] FCCC/CP/1995/7/Add.1
[2] FCCC/CP/1996/15/Add.1
[3] FCCC/CP/1997/7/Add.1
[4] FCCC/SBSTA/2000/CRP.8

secretariat for a password which would allow them to access and test the system. It then decided to consider this matter further at its fifteenth session.[5]

B. Purpose of the document

6. Following the SBSTA request, the main purpose of the present document is to provide a plan for a project implementing a technology transfer information clearing house and an international information network within the UNFCCC process. It provides preliminary information on the resource implications for the next year, 2002.

7. The document also contains information on the present status of work and useful information on definitions, technology classifications, database structures, information search criteria, classification of links to existing relevant web sites and competing technical solutions for implementing the clearing house as a web application. The secretariat hopes that this paper can provide the basis for developing a possible technical solution and options for establishing an UNFCCC technology transfer information clearing house. **The ultimate design is highly dependent on the type of information requested by Parties, particularly developing countries.**

8. This document should be read in conjunction with the previous documents prepared by the secretariat on these issues: "Initial report on and inventory and assessment of technologies to mitigate and adapt to climate change" (FCCC/SBSTA/1996/4 and Add.1 and 2), "Options for technology information centres and networks" (FCCC/SBSTA/1998/INF.2) and "Technology and technology information needs arising from the survey of developing country Parties" (FCCC/SBSTA/1998/INF.5).

9. Furthermore, the document is supplemented by a functional prototype of the information clearing house, which can be accessed on the Internet (http://ttclear.unfccc.com/ttclear/Jsp). The prototype was developed by the secretariat as a proof of concepts and it allows the reader to get hands-on experience of the different elements of the proposed project.

C. Present status

10. In order to address the needs of information on ESTs, the secretariat has pursued, since 1999, a project to establish a technology cooperation projects inventory (PTI database). In the spirit of the consultative process on technology transfer, initiated at COP 4, the project's aim was to explore what technology information is already available on the web with a view to assessing the gaps in geographical coverage and in specific services and products.

11. The inventory, containing at present some 1,200 projects and programmes, focuses on technologies that are actually being developed, diffused and transferred as a result of climate change-related development assistance and cooperation. At present, it includes GEF projects and programmes, projects cited in national communications of Annex I Parties[6], projects cited in consultative process submissions, Activities Implemented Jointly (AIJ) projects, projects identified by the Organisation for Economic Cooperation and Development (OECD), Development Assistance Committee (DAC) (in a consultant report), United States and German

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[5] FCCC/SBSTA/2001/2, para. 24.

[6] FCCC/SBSTA/1999/Misc.5.

technology cooperation reports, projects cited in initial national communications of Parties not included in Annex I to the Convention, some bilateral projects not reported in national communications of Annex I Parties, and some multilateral projects and programmes such as non-GEF related activities of the United Nations Environmental Programme (UNEP), the United Nations Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO), regional development banks and other multilateral implementing agencies.

12. The PTI database, developed and implemented using a desktop database management system (MS Access), has been designed to answer simple questions such as:

(a) What climate technology cooperation projects are being carried out in a particular host country?

(b) Who is carrying out technology cooperation projects and in what countries?

(c) What projects using solar technologies are being implemented?

(d) Whom can I contact about various projects?

13. The structure of the database, the data coverage, the main data entry form and an example of a report created by querying it are presented in annex A.

14. In parallel with this effort, the Climate Technology Initiative (CTI), with support from the United States and other member countries, was working with the secretariat on a pilot project on a "climate technology web site", for possible use by UNFCCC to support the consultative process on technology transfer, as well as to provide some near-term assistance to Parties in improving access to information on climate-friendly technologies. The pilot project demonstration site was posted on the Internet early this year. One of the most recent efforts is the design of an Internet-based registration system for technology transfer expert centres. The web site's main elements are presented in more detail in annex B.

15. The CTI has developed a search engine to help users to access quickly quality information on environmentally sound technologies, know-how and practices. A key capability of this search engine is that it allows for an advanced search by energy sector, technology, region or even source document. The complete list of the search criteria appears in annex I. The secretariat is cooperating with CTI and is currently assessing the possibility of using this engine in its technology information system clearing house.

16. In order to progress further in the implementation of an electronic technology transfer information clearing house, i.e. disseminating information, documents, responding to queries and so on, the secretariat has designed and developed a functional prototype. The alpha version of the prototype is described in some detail in annex C. The basic elements and functionality of the alpha version of the prototype were presented to the Parties at the first and second parts of the thirteenth meeting of the SBSTA.

17. Finally, the prototype was redesigned to enhance its technical performance, its alignment to UNFCCC standards for information technology applications and to the technical solution proposed in this document, and in order to maximize the use of existing on-line information, thereby reducing the resource implications of operating and maintaining the system. The beta

version of prototype, presented in some detail in section X of this document, provides access to information on the development and transfer of environmentally sound technologies under the Convention. The prototype is experimental and will require integration into a revised UNFCCC web page planned for the end of the year.

18. The proposed project will complement and work closely with existing web sites/clearing houses of other relevant international organizations and national/regional technology information centres. Annex O contains a short description of some of the most relevant web sites/clearing houses, which are connected to the functional prototype.

II. OBJECTIVE AND SCOPE OF THE PROPOSED PROJECT

19. The objective of the project, tentatively called TT:CLEAR, is to improve the flow of, access to and quality of the information on the development and transfer of environmentally sound technologies under the Convention and to contribute to a more efficient use of the available resources within the secretariat and to provide a synergy with ongoing efforts in other organizations.

20. The main components of TT:CLEAR are illustrated in figure II.1. The proposed structure contains a set of databases (TT:DATABASES), an internet information system (TT:IIS)[1], a set of tools for technology assessment and comparison (TT:TOOLS) and some validation and dissemination activities. For a better use of the resources available for implementing the project and to permit interim evaluation of the results, two phases are envisaged. The first phase will focus on establishing and updating the databases, designing, testing and implementing the TT:IIS and providing access to existing Internet resources.

21. Once the first phase is operational, a second phase could be undertaken, the development, testing and dissemination of a set of tools for technology assessment and comparison. This would be used in combination with the databases and the TT:IIS for performing simple sensitivity analysis on the capabilities and limitations of different technologies, taking local conditions into consideration, and for comparing different technological options conducive to mitigating and or adapting to climate change. This second phase is particularly dependent on the needs of Parties and other potential user groups and would be implemented only after extensive consultations.

22. The dissemination and validation of the clearing house products (databases, information system and tools) will be done through carrying out case studies and providing training in the use of the system with a view to establishing the technology transfer information network.

23. The clearing house will provide a means of accessing information in existing databases, both at UNFCCC and outside, through the Internet. For example, the UNFCCC roster of experts, the databases on AIJs, the Clean Development Mechanism (CDM) and Contact Information Server (CIS) may be connected with the proposed new databases. The GEF, International Energy Agency (IEA), Greentie and Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET), OECD/DAC, CTI databases and search engines will be used to search for information on different aspects of technology transfer. Furthermore, many analytical tools,

[1] Technology transfer internet information system – sometimes referred to as a technology information system.

such as those for energy planning, estimation of the potential of new and renewable energy sources (NRE) and energy efficiency, already exist and may be used.

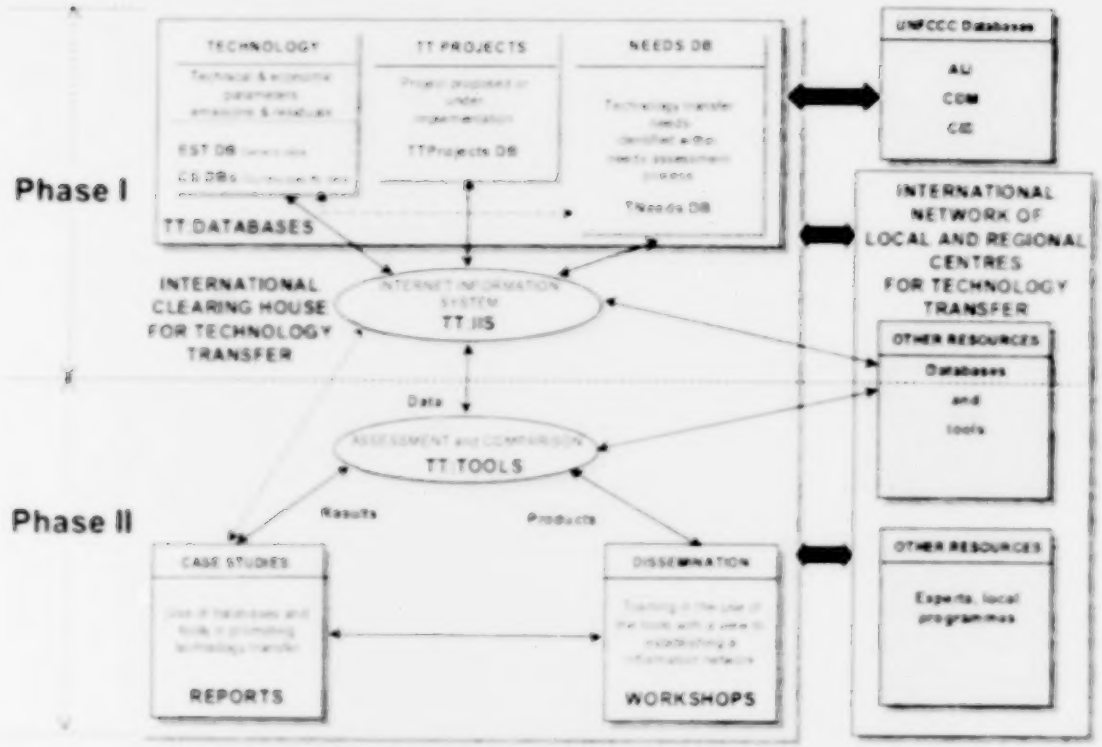

Figure II.1. Proposed structure of the TT:CLEAR

24. The main priority of the clearing house will be to deliver on-line information services through the Internet. However, consideration will be given to the needs to provide some information via hard copies and/or CD-ROMs.

III. TARGETED AUDIENCE AND POSSIBLE USES

25. Technology transfer is a broad set of processes, which involves different stakeholders such as governments, private sector entities, financing institutions, intergovernmental and non-governmental organizations (IGOs and NGOs) and research/teaching institutions (figure III.1).

26. The proposed clearing house targets experts from all of the above stakeholders, from regional specialists, public interest groups, non-governmental organizations (IGOs), lending agencies and trade associations to business and industry. However, it is expected that government representatives and experts in developing countries would be particularly interested in its content. The clearing house could also address specific requests from the SBSTA and support different programmes within the UNFCCC secretariat.

27. IT CLEAR could provide an accounting framework for technology transfer activities under the Convention, easily searchable by region, country and technology, which would significantly lower the transaction costs of assimilating information on project technology activities and allow efficient access to information on financial and technical resources for technology transfer. It could also contribute to improved donor coordination and to better planning and implementation of sustainable development projects, especially in developing countries. It could provide information for the preparation of project proposals to the GEF and possibly be used to help prepare or check baselines for CDM projects.

Figure III.1. Stakeholders involved in technology transfers

Source: IPCC Special Report on Methodological and Technological Issues in Technology Transfer, IPCC, 2000 [7].

28. The clearing house could act as a one-stop database on technologies and thus ensure coherence, consistency and easy accessibility to information in order to support those interested in the technical, economic and environmental aspects of climate-friendly technologies. For instance, economists, engineers and scientific experts from universities and research centres may find the clearing house a valuable source of information on quantitative and qualitative data, which may be of use in research and policy studies. At the regional and international level, development banks and economic commissions might use the IT CLEAR for establishing technical assistance projects relating to climate change.

29. The effectiveness of the international clearing house will be critically dependent on its ability to (a) simplify users' access to information on climate-relevant technologies and (b) provide 'user-tailored' services, directly relevant to the user's needs.

IV. OPTIONS FOR CONSIDERATION BY THE PARTIES

30. Parties may wish to consider establishing the technology transfer information support system (clearing house) to serve as the main gateway to enhance the Parties' access to information on environmentally sound technologies by deciding to implement:

(a) phase I,[5] that is, the further development of the functional prototype, creating the first version of the Internet Technology Transfer Information Support System, the initial design of the databases, and data collection, entering, maintenance and update; and/or

(b) phase II, which includes the design and implementation of TT:TOOLS and the dissemination of technology products.

31. The Parties may also wish to consider a review process for the project after each implementation phase.

V. PRELIMINARY RESOURCES ESTIMATE (PHASE I)

32. **Estimated expenses (2002)**

1. Further development of the functional prototype and creation of the first version of TT:CLEAR	**US$**	**300,000**
2. Preparation and convening of two or three expert meetings to determine role/contribution of Parties, data gathering, technology classification and peer review of information	**US$**	**150,000**
Total (Minimum funds needed from supplementary funds and or from fund raising)	**US$**	**450,000**

The resources implications of phase II are difficult to estimate at this stage. They are interdependent with the number of TT:TOOLS modules to be developed, the number of case studies and other dissemination activities. However, the design and development efforts will be smaller than for the first phase.

VI. PRODUCTS

A. Databases

33. The process of technology transfer requires a comprehensive and consistent set of information. Such a set of data is broad and complex and includes a number of data already compiled and stored in existing databases. Therefore, the TT:DATABASES will be designed in a modular fashion. These databases will include:

(a) **Technology Transfer Projects Database (TTProjects DB):** storing data on technologies that are being developed, diffused and transferred as a result of climate change related development assistance and cooperation projects.

(b) **Environmental Sound Technology Database (EST DB):** providing generic data on different technologies conducive to mitigating and adapting to climate change, presently marketed or expected to come into operation in the next decade, including their technical

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[5] Phase I of the project could be further divided into two parts based on the priorities given to different tasks: part A to include the high priority tasks and part B to include medium and low priority tasks (table VIII.1). Also, estimates may vary considerably depending on the level of indirect support from governments, the desired level of quality and the final performance characteristics desired by Parties.

performance, economic characteristic and airborne emissions of greenhouse gases (GHGs) and other pollutants.

(c) **Technology Needs Databases (TTNeeds DB):** containing different ESTs identified by developing country Parties within the technology transfer needs assessment process.

34. Auxiliary databases will also be established to support the main databases. They will include a database of links to Internet resources relating to technology transfer, a database containing references to sources of information used in the main databases, a database of experts, a database of national and regional centres for technology transfer and a database of parameters such as global warming potentials.

35. The remainder of this section will consist of an analysis of the main characteristics of each of the proposed databases. Because many of the database design elements are similar, they have been grouped in one subsection. Furthermore, recognizing the importance of data gathering, consistency checking, validation and sharing, a special subsection was added on this topic.

1. Technology transfer projects database

36. Establishing a comprehensive inventory of climate-friendly technologies cooperation projects is a difficult and demanding task. Therefore, the scope of TTProjects DB will continue to be limited to technologies which are actually being developed, diffused and transferred as a result of climate change relevant development assistance and cooperation.

Table VI.1. Codification of project status and type of assistance

Cod	Status	Explanation	Cod	Type of assistance
1	Planned	From the conceptual stage to just prior to approval	1	Grant
2	Ongoing	The activity is approved, is active, but is not yet completed	2	Loan
3	Completed	The activity is finished, with all approved assistance provided	3	Credit
4	Cancelled	The activity was approved but was terminated prior	4	Equity investment
5	In abeyance	The activity has been suspended before completion	5	Donation
6	Committed		6	Other
			7	Multiple

37. The starting point for establishing this database should be the project technology inventory (PTI database), described in section I.D of this document. However, the PTI should be re-designed to correct the errors in its data structure (see annex A), to increase its coverage by adding new fields of information (such as CO_2 reduction, project status, project elements, project officer, project URL, multiple contacts, project categories), and to make it consistent with similar project databases. Table VI.1 illustrates the codification which will be used for the project status

and for the type of assistance[9]. For illustrative purposes, the data coverage of the PTI is compared with other similar databases in annex D.

38. Considerable institutional capacity to provide information relating to transfer of environmentally sound technology cooperation projects and know-how already exists within United Nations organizations, regional development banks, specialized agencies, and national and regional networks of technology centres. Therefore, information sharing over electronic networks such as the Internet will be a key element for successful implementation of the proposed system.

39. In order to achieve efficient electronic information sharing, the following approach will be used:

(a) TTProjects DB will store only information on mitigation and adaptation projects and programmes directly relating to the development and transfer of technologies under the Convention such as projects and programmes cited in national communications of Annex I Parties and projects cited in consultative process submissions, AIJ projects and projects cited in initial national communications of Parties not included in Annex I to the Convention. The access to information on other relevant projects will be possible through the Internet using TT:INFO.

(b) The database structure will follow as far as possible, the proposed IDML[10] standard. For more details on IDML see annex N. However, the above proposal does not cover some UNFCCC specific data such as technology classification and project elements. Therefore, this structure will be extended to cover additional data elements.

(c) The classifications and codifications used in the database will be harmonized with other UNFCCC classifications (such as common reporting format (CRF), roster of experts (ROE)). Details on existing classification systems for technologies (mitigation and adaptation), economic sectors, fields of expertise, web links and information search criteria can be found in the annexes to this document.

(d) A marker system, similar to the one in use by OECD/DAC (see appendix D), may be developed for technology transfer projects and programmes. The system would allow classification of climate change related projects and programmes into three levels, according to their contribution to the transfer of environmentally sound technologies: "principal objective", "contributes to" and "no elements".

40. The tasks and resource implications for establishing the TTProjects DB are summarized in table VI.4. Note that some of the tasks are related to the TT:IIS; their resource implications will be covered later.

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[9] The proposed codification is consistent with International Development Markup Language (IDML) and is used by several international organizations, including OECD and the World Bank.

[10] http://www.idmlinitiative.org/index2.cfm

Table VI.4. Tasks and resource implications for establishing the TTProjects DB

Tasks	Resources	Actors
Redesign PTI as described above and establish TTProjects DB	1 week	secretariat
Establish systematic and transparent criteria for selecting projects, programmes or other activities to be included in the database	1 month	all Parties secretariat
Database maintenance and update • Update with projects technologies second national communications of Annex I Parties and initial communications of Non-Annex I Parties • Incorporate projects and programmes not currently in the database such as the 35 case studies included in the IPCC Special Report and TCAPP projects • Questionnaire to IGOs donor countries	continuous 3 months for proposed updates	secretariat all Parties
Peer review of the existing database using the web	1 month	all Parties
Enhance the function which allows Parties to change enter further projects	2 weeks see data entering module of TT IIS	consultants secretariat some Parties
Enhance the search engine to extract data from TTProjects and external databases (CTI, Greentie, CADDET),	see data search module of TT IIS	consultants secretariat some Parties
Link the database with the database of other international organizations(e.g. GEF, UNIDO), multilateral development bank (MDBs), regional and national technology transfer centres	through TT CLEAR web page	consultants secretariat some Parties
Total	**2 months**[11]	

2. Environmentally sound technology database

41. The aim of EST DB is to provide harmonized information on technical parameters, economic characteristics and environmental aspects of climate-friendly technologies. This database will constitute a large, although not exhaustive, inventory of EST technologies currently used and or under development. As the number of climate-friendly technologies at present available for different sectors of economic activities is very large, the EST database will use the concept of generic and representative technologies to reduce this number to a manageable size. In EST DB terms, a **generic technology (GT)** is a set of generic attributes used to represent typical characteristics for a class of technology systems. The generic technology, in general, does not represent any particular system, but rather a composite of several technologies of the same type having characteristics that are typical of the technology class. For instance, a generic technology called combustion turbines 100 MW could be established for a class of stand-alone combustion turbines having a particular configuration or design.

42. The development status of the ESTs varies from mature technologies to commercially available (without long market experience), demonstration technologies, pilot technologies, laboratory experiments and even proof of concepts or idea. Therefore, case by case, GT will stand for:

[11] Does not include the time needed by Parties for the peer review

(a) Current application average - The typical technology represents the "average of conventional (mature) technologies currently in use in the field (e.g. the average of the inventory of combustion turbines now being used in utility peak power generation applications).

(b) Best available practice - The GT descriptions characterize a technology that is representative of the "current best practice systems which are now commercially available" (e.g., one of the best performing types of new systems recently on the market with some installations).

(c) Next available generation - The GT may be interpreted as the next level or generation of systems, which are now successful prototypes with the expectation of commercial availability in the near term - less than three years (e.g. typical performances of an emerging class of high efficiency turbines when they are available).

43. In some situations, such as for adaptation technologies or fuel extraction technologies, it is more difficult, if not impossible, to define generic technologies. Each mine has particularities that make it different from other mines and therefore the data cannot be extrapolated to other situations. To deal with these situations a **representative technology (RT)** will be stored in the database. In these cases, the data will be collected for real technologies (mines) accounting for a significant share of the world level production or representing a typical situation, de-facto standard or market leader.

44. EST DB will be designed for use by analysts to evaluate the various technology options which are potentially attractive for near and mid-term applications. The inventory is intended for area-wide technology screening studies. Some applications for which the data would be well suited include the following:

(a) Preliminary evaluation and screening of climate-friendly technology options to be transferred to different regions of the world;

(b) Area-wide economic and environmental development planning, including application of technology options and assessment of the resulting technical, economic and environmental impacts (mainly when country-specific data are not available);

(c) General comparative assessment studies of different technology options in terms of their life cycle GHG emissions.

45. The performance of the ESTs can be significantly different when implemented in a given country. Therefore, additional information and tools may be needed to customize the generic data for local conditions, and some Parties may consider the option of creating their country-specific databases based on the EST structure, to be used in their national technology transfer centres. For illustrative purposes, some of the factors influencing the performance of a fossil fuel fired power plant, are:

(a) Generating unit design basis: duty cycle, unit size, location, cost boundary, ambient conditions, emissions standards, design philosophy and shared equipment;

(b) Cost-estimating basis: Consistency of cost data and performance data, capital investment, total plant cost, total capital requirement, operation and maintenance (O&M) costs and fuel prices.

46. One of the first tasks for establishing the EST DB and clarifying its coverage will be to develop a technology classification system which is broad enough to cover all the classes of technologies involved in the technology transfer process and, at the same time, flexible enough to accommodate future technologies, which is not complicated, and which is compatible with existing sources of information. Further details about this task are given in annexes E and J.

Table VI.5. Tasks and resource implications for establishing the TTProjects DB

Tasks	Resources	Actors
Design and implementation of EST DB	2 weeks	secretariat
Establishing, adoption of a technology classification system	2 weeks	secretariat
Initial data gathering and consistency checking	1 month	consultant secretariat
Database maintenance and update	continuous	secretariat all Parties
Peer review of the database using the web	1 month	all Parties
Creation of a function to allow Parties and private industry to change offer/technologies	see data entering module of TT:HS	
Implementation of the search engine to extract data from TTProjects and external databases (e.g. TT: Clearing; CADDET)	see data search module of TT:HS	
Linking of the database with databases of other international organizations (e.g. GEF, UNIDO), MDB, regional and national technology transfer centres	through TT:CLEAR web page	
Total	**2-3 months**	

3. Technology transfer needs database

47. This database will contain the ESTs identified by developing country Parties within the technology transfer needs assessment process and or reported in their initial national communications. The database structure will be similar to the EST DB structure. In most cases, the database will only store pointers to technologies included in the TTProjects DB, EST DB or for other sources of information available over the Internet. However, the database may also contain full descriptions of special technologies not available in the above-mentioned sources of information.

48. For illustrative purposes, the list of projects submitted to the secretariat by Azerbaijan in its initial national communication is presented in table VI.6.

Table VI.6. List of the projects submitted by Azerbaijan[12]

#	Project
1	Introduction of wind turbines for energy production
2	Energy efficiency by means of CFL bulbs application
3	Use of hydro-resources with a view to constructing smaller HPP's
4	Creation of integrated and automated energy supply accounting and management system in Sumgait
5	Introduction of energy-efficient technologies in the Samur-Absheron irrigation canal
6	Introduction of the latest energy-efficient technologies in oil production
7	Assessment of technological losses occurred during production, transportation and refining of oil
8	Introduction of new technologies for collection and utilization of accompanying gas of low pressure
9	Application of latest technologies for the rational use of fuel in oil refineries
10	Installation of new energy efficiency technologies in Azerbaijan's gas transportation system
11	Installation of control and measuring equipment for the distribution of natural gas in residential and commercial sectors
12	Production of energy from manure produced by livestock
13	Pilot project on energy production from agricultural wastes of Nakhchivan AR
14	Pilot project on introduction of new technologies for methane collection, with a view to producing energy from municipal wastes of Sumgait
15	Utilization of solar energy for heating of water
16	Installation of new technologies on the railway system.
17	Introduction of new energy-efficient technologies in the gas transportation system of Azerbaijan
18	Plantation of field-protecting forests on 25,000 ha.

4. TT:DATABASES design

49. Database design is the process of developing a database structure based on user data requirements with four major steps: requirements formulation and analysis, conceptual design, implementation design and physical design [10]. At this stage, we shall make only some general remarks relating to requirements formulation and analysis for the TT:DATABASES.

(a) The information to be stored in these databases is given in numerical, textual and pictorial form in order to allow the user to obtain a comprehensive overview of the ESTs and technology transfer projects.

(b) The *numerical* information covers technical parameters, economic performance and environmental factors (see annex F);

(i) The representation of *technical* parameters is limited to basic information, including reliability, which describes technical features in adequate detail but without describing in detail characteristics which are site and manufacturer specific. Such "in-depth" information can be covered in the external databases;

(ii) The *economics* are considered only at technology or project level. The data may be aggregated into one figure or broken down into main categories such as total overnight costs, operation and maintenance costs, fuel and raw materials costs, construction period, economic lifetime, etc.;

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[12] Source: initial national communication of Azerbaijan.

(iii) The *environmental* parameters addressed in EST DB cover emissions of airborne pollutants, in particular GHGs. As far as possible, other emissions such as "acid rain" gases (e.g., sulphur dioxide and nitrogen oxides), non-methane hydrocarbons, particulate and volatile organic compounds, water effluents and solid waste, as well as more general environmental parameters such as land requirements, noise, visual intrusion, and so on, will also be covered.

(c) To address the uncertainties associated with the numerical values, ranges should be used. For each numerical entry three values will be stored: minimum, average and maximum. Furthermore, one could consider adding the time dimension to these values and adding short descriptions to numerical entries.

(d) One of the major difficulties that had to be overcome in implementing the numerical part of the databases was the necessity to store information for a wide variety of different technologies defined by different characteristics (e.g. a gas turbine power plant and a modern truck transportation system). One solution to this problem is to store in the database, together with the numerical values, the list of technical, economic and environmental characteristics (the characteristic name, unit of measurement, etc.) needed to describe a particular technology. This technique allows construction of a very flexible database model. Additional characteristics can be added to the database as new technologies are added.

(e) The sources of information should be made available for each technology project to enhance the credibility of the databases. If different from the main reference, additional references and comments will be provided for each number stored in the database.

(f) Descriptive information, textual and pictorial, is provided to support the numerical information. This information will provide details on the technical design, cost estimations, emission data, general considerations about the possible evolution of the technology, and basic information on how to maintain and service the technologies and firms who can provide service and others. The textual descriptions will be complemented with pictorial information, schematics and diagrams. This information will be stored as web pages, in HTML format, with hyperlinks to other relevant information. For illustrative purposes, descriptive information for several electricity generation technologies is given in annex G[13].

5. Data sources, gathering and consistency checking

50. The secretariat receives information relating to a large number of technologies, either currently being developed or in use. This information is available via:

(a) Written material. Journal articles, technical reports, books and newsletters;

(b) Databases. Information stored in computerized databases, which can be obtained on diskette or accessed on-line. In addition, a hard copy of information contained in the database is often available upon request;

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[13] Carbon dioxide recycle power plant, integrated gasification combined-cycle (IGCC), natural gas-fired combined-cycle with heat recovery, pulverized coal with flue gas desulphurization (PC+FGD).

(c) Workshops and training courses. Some institutions conduct workshops and training programmes on specific technologies;

(d) Submissions from Parties.

51. The type of information available on technologies varies considerably. For illustrative purposes, table VI.7. below gives selected examples of different types of reports. In many cases, however, it is difficult to categorize a report since the contents address several subject areas.

Table VI.7. Examples of different sources of information

Content	Description	Example
Research and development projects	A description of laboratory, bench scale or other experiments	"Solar thermal power and solar chemical systems", SolarPACES, IEA, 1994
Demonstration projects	A description of technology or practices tested on a small or limited scale	"Photovoltaics provide electricity to rural communities in the Philippines", Centre for the CADDET, 1995
Product description	A catalogue of technical information and prices for specific products	"The Australian renewable energy industry", Department of Primary Industries and Energy, Australia, 1993
Multiple technology assessment	A comparative analysis of the performance, environmental impacts and cost of several technologies or practices	"Options for reducing methane emissions internationally, vol. 1: technology options", United States Environmental Protection Agency, 1993
Programme report	The results of a programme conducted over a number of years to develop or introduce a technology or process in a country or region	"Implementation programme: reduction of environmental impact from coal in Central Eastern Europe", UNDP, 1995
Case study	A summary of the technical, financial, institutional and other aspects associated with deploying a new technology in a country or region	"Local and regional energy-related environmental issues", World Energy Council (WEC), 1995
Cost-effectiveness study	A study of the costs of different technologies	"Renewable energy technologies: a review of the status and cost of selected technologies", World Bank, 1994
Government policy report	An integrated report on policies, measures, and technologies	"Energy management in Africa", African Energy Policy Research Network, 1992
Bibliography	A description and identification of reports, date of issue and authorship	"Energy conservation in industry", Industrial and Technological Information Bank (INTIB), UNIDO, 1994
Institutional directory	A list of organizations working on a particular technology	International Directory of Energy Efficiency Institutions, World Energy Efficiency Association (WEEA), 1995

52. Data gathering remains a resource-intensive task and clear procedures to perform it should be defined. Automatic data collection, through the Internet, should be the main vehicle for carrying out this task, and special modules would be defined in TT:IIS to allow for this functionality. The data collection activities of the information clearing house will be related only to those data not covered in the external databases.

53. Owing to the nature of information provided in TT:DATABASES, the databases require maintenance and updating on a regular basis in order to keep pace with technological developments and new technology transfer projects. This task can be very time and resource-intensive. One inexpensive and accurate solution to this problem would be to allow different stakeholders to update their information themselves through the Internet.

54. Another option is to rely heavily on external sources of information. However, it remains to be seen how far access to certain external databases may be achieved through alliances between the clearing house and existing suppliers of technology information (for example a formal alliance with IEA Greentie or CADDET).

B. Internet information system

55. The technology transfer information clearing house will be implemented in the form of a specialized web site, which will serve as the main gateway to enhance the environmentally sound technology information network in support of the Convention.

1. Requirements for the information clearing house web site

56. At the regional workshops on the technology transfer consultation process, participants supported the idea of development of a UNFCCC clearing house web site dedicated to climate-friendly technologies. On these occasions, many constructive issues and suggestions were raised concerning the preliminary design of the web site. The following table outlines some of the issues raised, followed by possible options for how to proceed with the development of the site.

Table VI.8. TT web site requirements identified in the consultative process and possible solutions

Issue	Options
Ensure that site information is easy to download for those without access to the latest technology.	• **Make the site available in text-only format.** Many developing countries do not have access to high-speed modems or large monitors. Therefore, TT:CLEAR should include an option for text-only download. • **Use "ALT tags" to represent graphics.** By using HTML's ALT tags, visitors are not required to wait until graphics download to find out what the graphics represent. Instead, a word or group of words, such as "UNFCCC Logo," will appear on the screen. A visitor can then decide whether they would prefer to wait for the entire graphic file to download or instead to continue browsing through the rest of the site. • **Create option to send site text to e-mail.** By offering site visitors the opportunity to send the content of the web site to either their own e-mail or someone else's e-mail, they are able to access the text without concern over the speed of their modem.

Issue	Options
Gather content.	• **Add content relating to the consultative process**. The UNFCCC secretariat should extend coverage of this part of the site, adding information such as country papers, presentations, meeting agendas, updates on the negotiation and consultative process, and other relevant publications and information. This section will be targeted primarily at the Parties but will not be password-protected. • **Add a threaded discussion to support the consultative process**. A threaded discussion can be developed that will be used to facilitate communications between the Parties. • **Link to expert databases**. Links could be provided to the expert databases currently being developed by CREST and GEM, as well as to other high-quality international databases of experts such as the Greentie, CADDET renewables and energy efficiency databases. • **Explore content-sharing relationships**. As interested individuals and organizations present themselves, it may be a good opportunity to collaborate with them to develop content for the site. For example, because the CTI spent a large amount of resources developing a comprehensive site and effective search mechanism, the site should simply link to that site. As the site develops, it is likely that many organizations will offer information to add to it.
Track visitors to the web site. Visitors to the site can be tracked according to where they come from and what kind of technology they are using. Through this tracking, it may become evident that certain sections of the site are more useful while other sections are rarely visited. This information will help inform ongoing improvements to the content, navigation and structure of the site.	• **Use web-tracking software**. Such capabilities should be added, and regular evaluation of the traffic performed, in order to improve the value of the site.
Develop a rating system for financial sources and technology sources listed on TT:CLEAR. Because the UNFCCC cannot endorse a particular product or funding source, the development of a rating system would enable visitors to share their personal experience with a company or individual on the web site.	• **Develop a rating system for the sites listed on the site**. By developing a rating system, site visitors can gain from previous visitors' experience. The rating system will also clearly show that the UNFCCC is not endorsing a given site, but providing a link to it strictly as an additional information source. One example of a rating system would be to allow a user to add an on-line comment by completing a short form or an on-line voting system. The form would then be sent to a moderator for review and be posted to the site. Users interested in viewing these comments would simply choose "view comments" and all of the comments about the particular site would be displayed.
Ensure that the site includes a "buyer beware " statement.	• **Develop a buyer beware statement for the web site**. Many sites display a type of "buyer beware" statement at the top of the site to ensure that visitors know that the links provided have not been endorsed by the company. The development of such a statement for TT:CLEAR will provide important clarification on the many sites listed.

Issue	Options
Encourage others to contribute information to the web site. One respondent was concerned that competing web sites might emerge to become portals to a broad range of technologies and funding information. Instead of competing with these sites, it is important to encourage all interested visitors to share information and ideas with the UNFCCC web site so that the portal remains dynamic and useful.	• **UNFCCC secretariat to designates a person to update and maintain or oversee the consultative process section of the web site**. Third party or disparate content experts can propose content that would then be approved by the UNFCCC and posted to the site. • **Create links to and rely on existing high-quality, neutral web-based resources.** The Parties stressed the need to conserve resources by linking to high-quality web sites and databases that already exist on the web. For example, the CTI has recently developed a list of high-quality databases and information sources that can be linked to from TT:CLEAR.
Ensure that the site can be searched with accurate results. The need for a highly intelligent search engine was also raised repeatedly. There was a concern that too many existing search engines simply provide a site visitor with thousands of sites that are often off the mark or unrelated to the topic.	• **Link to existing highly accurate search mechanisms**. Through a process of trial and error, CTI has created a search function on their site that ensures the accuracy of search results. This function involves a combination of an on-staff indexer and database and will be unrolled on their revised web site next month. TT:CLEAR can more clearly and directly link to this comprehensive and highly accurate search mechanism. Other existing search engines in specialized areas (such as pollution prevention/cleaner production) also exist on other sites and could be connected. • **Develop a search engine specifically for TT:CLEAR**. A search mechanism is also planned to search only the TT:CLEAR site to ensure that information on the consultative process is easy to find.
Create a list of reputable sites with "objective" information to lead developing countries to reliable sources of information. Respondents were concerned that without such a list, developing countries would not know where to begin when searching for information on TT:CLEAR.	• **Develop a list of "objective" web sites.** The development of a list of sites that have been deemed reputable or objective by the UNFCCC may assist developing countries in their search for quality information about given technologies. The site may include web sites of governments and/or multilateral organizations or may simply include a list of names and contact information. It is critical that criteria be developed for these "objective" sites so that it can easily be determined which sites should be included in this group.
Provide a similar look and feel to the UNFCCC web site and consider integration with this site.	• **Use UNFCCC format for TT:CLEAR.** This option will provide full compatibility with the present UNFCCC web site. • **Use an advanced format (frames, top banner and left navigation frame)**. Although not fully compatible with the present format, this option has easy navigation and structured information display. It will be also simpler to maintain and update.

2. Functions

57. The main function of TT:IIS is to provide enhanced access to climate-related resources. The information system should cover some of the upstream, midstream and downstream activities related to technology transfer (see table VI.9). Furthermore, the system should follow the structure of the framework for effective actions for enhancing the implementation of Article 4.5, currently under negotiation between the Parties.

Table VI.9. Stages and functions of a technology transfer framework

International information clearing house and network Stages of technology transfer-related activities		
Upstream[14] →	Midstream[15] →	Downstream[16]
• Needs assessment • Technology assessment • Capacity-building • Public-domain technology inventories • Donor coordination • Public-private networks • Partner matching • Government agency capacities • NGO capacities • Research and development organization capacities • Legal regulatory framework	• GEF projects (medium-sized project vehicle of GEF) • Bilateral projects • Public-public transfer • Private investments (including licensing)	• Project evaluation • Project sustainability • Mechanisms for replication of midstream projects, investments and technology transfers

58. The functions of TT:IIS have been grouped in modules. The modules, interlinkage, as well as the connection with the different actors involved in the development and use of the clearing house, is illustrated in figure VI.1. Other modules may be added to the system as implementation proceeds and needs change. Some functions, such as reporting on the implementation of Article 4.5, are not yet clear and will not be considered at the present stage.

[14] Activities generally corresponding to "assessment and agreement" stages of technology transfer as described in the IPCC Special Report.

[15] Activities corresponding to the "agreement" and "implementation" stages.

[16] Activities corresponding to the evaluation and replication stages.

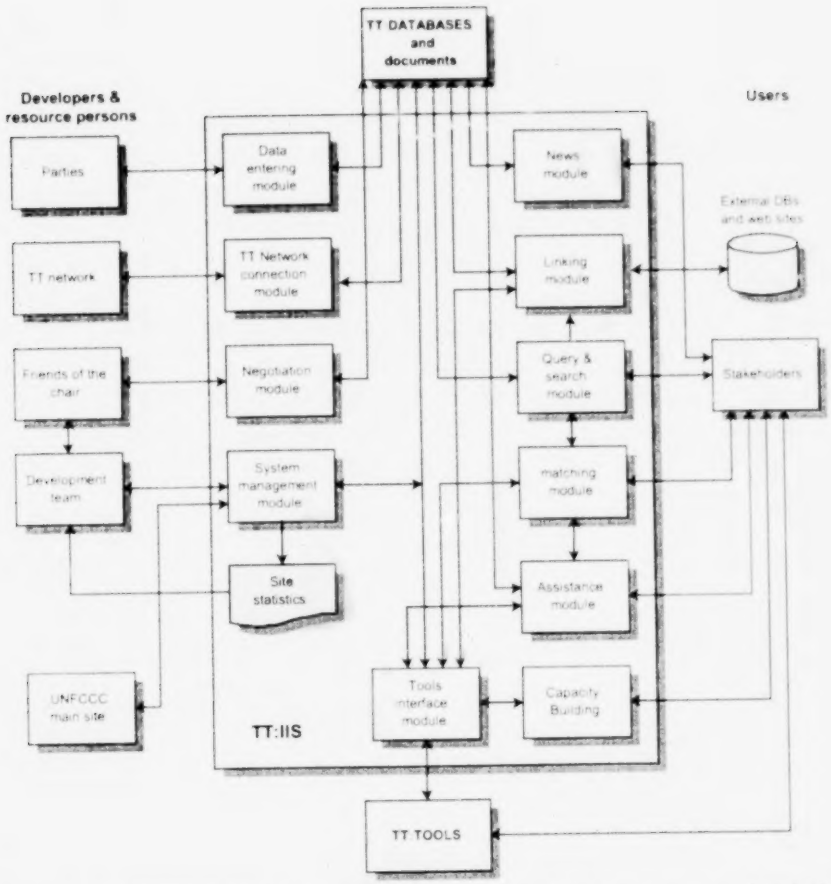

Figure VI.1. Main modules of the TT:IIS and linkage with developers and stakeholders

59. A summary description of the functions to be covered by each module follows:

(a) **Data-entering module**: This module will cover data gathering, updating and peer review using the principles of distributed content management and stakeholders' involvement. Some of its functions are:

- To include distributed content management features that can enable a number of content managers to post information directly to the web site;
- To register, delete and update TTProjects DB[17], ESTs DB, and TT Needs DB;
- To have the databases peer-reviewed by the Parties themselves through the Internet;
- To register, delete and update regional and national centres and experts (jointly with the network management module);
- To register, delete and update Internet resources (e.g., sites, databases, search engines).

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[17] Available for testing

(b) **News module**: The main task of this module will be to provide information on the current status of the technology transfer process. Some of its functions are:

- To provide access to the status of the negotiation process on technology transfer and to the issues under negotiation;
- To maintain, update and publish a calendar of events and to keep track of the outcomes of these events;
- To provide access to recent documents including UNFCCC documents relating to the consultative process on technology transfer;
- To provide access to UNFCCC resources (e.g., official documents, newsletters);
- To use a rule-driven image display of banners, which enables messages to be tailored to individual site visitors. To apply marketing principles by using a database of banners, grouped into campaigns, and to display the most appropriate banner;
- To provide a forum for on-line exchange of views on technology transfer through news groups, chat facilities and list-servers (chat 1 – open).

(c) **TT network connection module**: This module will act as the gateway for the technology transfer information network. Some of its functions are:

- To register and update national and regional centres and experts registration, and facilitate awareness about their services and technologies (jointly with (a));
- To maintain a technology classification system and cross-reference tables to be used by the search module (jointly with (d));
- To coordinate activities in the network;
- To connect public with private networks.

(d) **Linking module**: This module will maintain and update the database of links to Internet resources on technology transfer. Some of its functions are:

- To consolidate technology information already available on the web by developing, maintaining and updating a classification system for Internet resources (see annex H for more details);
- To maintain a directory (database) of links classified according to the criteria developed above and to provide links to these resources (see annex J);
- To implement a rating system for the external sites;
- To act as an interface (translator) between the conventions used on external sites and TT:CLEAR;
- To search and categorize sites using automatic procedures.

(e) **Negotiation module**: This module will provide restricted access to special information for the friends of the chair group. Some of its functions are:

- To provide a chat facility for the friends of the chair enabling them to share ideas and information in a more structured manner than is currently possible using e-mail alone (chat 2 – close);

- To provide password-protected access to a series of web pages where negotiators could post and read relevant information and take part in virtual technology consultative process meetings inter-sessionally.

(f) **Query and search module**: This module will support a query service by linking to information sources and databases and by searching for specific information (see annexes I and J). Some of its functions are:

- To establish a unique search engine that could simultaneously search other sites or utilize other search engines. The advantage of such a search engine would be that the user would have greater confidence in the search results - positive or negative;
- To search Internet and local resources on topics including public domain technologies, IGOs, NGOs, knowledge institutions (research and development) and legal/regulatory framework;
- To provide numerical information in the formats specified by other modules (TT:TOOLS);
- To provide a graphical interface for querying the TT resources and presentation of the results.

(g) **Matching module**: This module will analyze demand for technologies (TTNeeds DB) and supply of technologies (EST DB) and match potential joint-venture partners. Some of its functions are:

- To match needs with existing technologies;
- To match partners;
- To advertise opportunities.

(h) **Assistance module**: This module will provide access to technical and financial assistance. Some of its functions are:

- To provide access to list of experts available for technical and financial expertise;
- To provide links to technical and financial assistance sites based on users' requests;
- To provide support for preparation of the documentation needed for financial help (such as preparing the documentation for funding from GEF);

(i) **Capacity-building module**: This module will provide an electronic learning environment. Some of its functions are:

- To provide distance learning (such as on-line seminars on technology transfer process, getting technical and financial assistance, TT:TOOLS);
- To display information on case studies and model projects.

(j) **System management module.** Some of the functions of this module are:

- Users registration, password[18] and profile maintenance and user-tailored information;

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[18] There are several groups of "users" with different roles and levels of permission: administrators, secretariat staff, Parties and public users.

- To track users, prepare statistics regarding site use, site rating;
- To provide facilities for automated system monitoring, site integrity checking and remote system control. Server's logs and bug tracing;
- Database management to enable the databases to be kept current, and to protect vital data collected by the site. The databases would be maintained independently of the web server, to be efficiently uploaded to the server without any service interruption;
- Integration with the UNFCCC main web site;
- Virus protection;
- Multilanguage support.

(k) **Tools interface module**. Some of the functions of this module are:

- Integration with TT:TOOLS. Provision of interface between analytical modules and information sources;
- To link TT:TOOLS to other modules.

3. Design

60. The following principles guide the TT:IIS design:

(a) Adoption of a modular structure, which allow many governments and organizations to contribute and which would also allow for a better use of the existing resources;

(b) Adherence to the incremental implementation principle. This would allow for a review of the software development after each phase and extensive consultations with the Parties and would also permit better management of the new resources;

(c) Cooperation with ongoing initiatives and promotion of efficient data gathering using modern techniques, through the Internet. Collection of information not available in external databases.

61. The goals of modern web application projects should include object-oriented design and aspects such as reusability, flexibility, maintainability and portability. Based on these criteria, and taking into consideration the present Internet system in use at the UNFCCC, a proposed structure for the information clearing house application is presented in figure VI.2. The structure is an evolution from the functional prototype prepared by the secretariat (see annex C). It is based on the JavaServer Pages (JSP) technology and implies no modification to the Internet web server (Apache) currently used by the UNFCCC.

62. The system includes a web server (Apache), a JavaServer Page container and web server (Tomcat), an XML publishing component (COCOON), an Internet services server (SOAP) and a database management system (MS SQL).

63. The XML component may be used for parsing external XML data and for publishing data in XML and pdf formats. It is of particular importance for aligning TT:INFO to IDML.

64. Tomcat includes a servlet engine used to run small server-side java programmes, which extends the functionality of the web server (e.g., the technology forum, chat rooms, web log analyser). It also converts the JavaServer Pages into dynamic servlets and HTML pages.

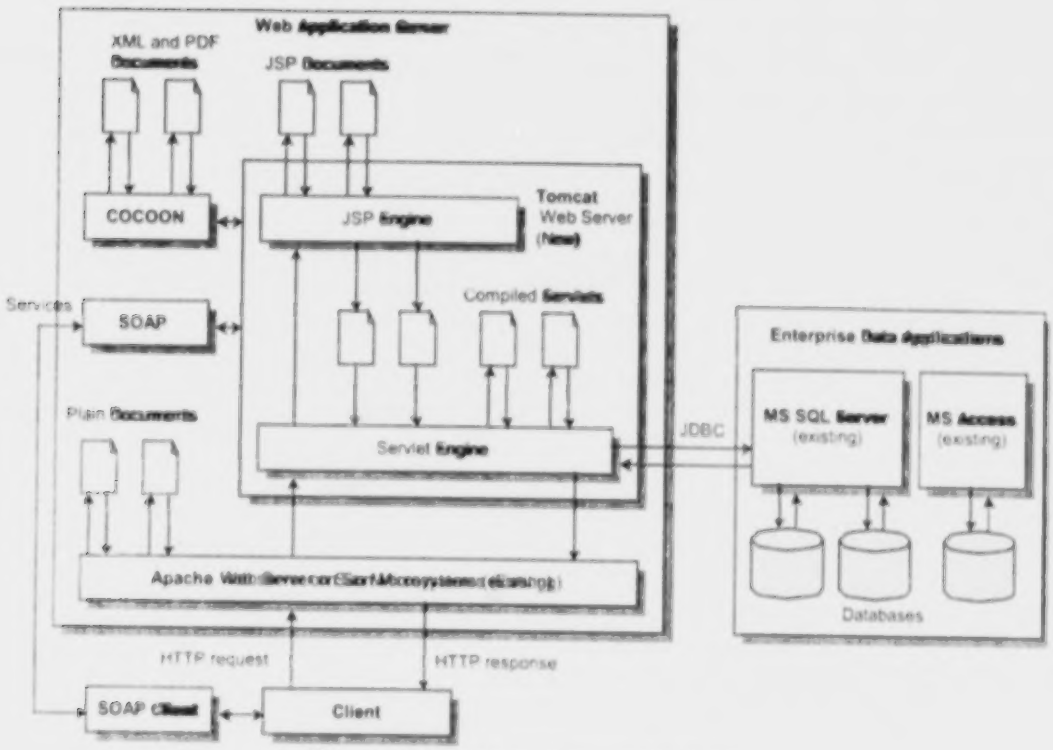
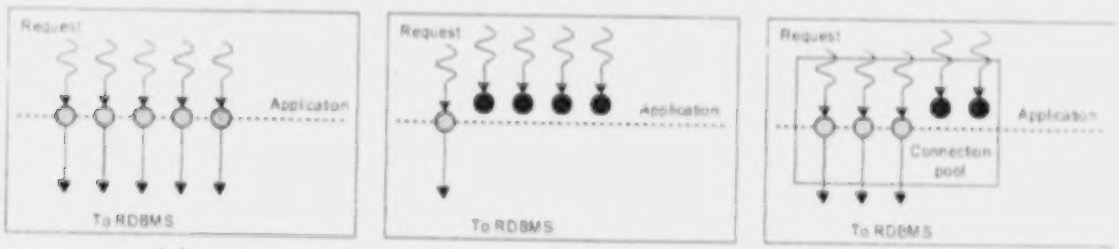


Figure VI.2. Web application structure

65. The SOAP server was included to allow for future extension of the system in the area of providing Internet services directly to specific applications over the HTTP protocol. These services can range from simple data services such as database searches to complex on-line project documents preparation and electronic procurement.



(a) (b) (c)

Figure VI.3. Tuning the access to the database

66. The accesses to the database server will be made through Java drivers (JDBC). Figure VI.3 illustrates three options for connecting to a database:

(a) A new connection for each request. In this case, multiple requests to the database can be entertained at any time. Each thread executing the JSP instance will create its own

database connection. The disadvantages of this type of connection are: limitation by number of licenses for the DBMS; exhaustion of system memory; and concurrency limit of JSP engine.

(b) Only one connection to the database. Has the advantage of creating a single database connection, at the initialization of the JSP, which will be used by all subsequent requests. All the request will be processed serially which results in a very slow access.

(c) Connection pool. A pool manager creates and maintains pools of database connections. All connections in the pool are to the same JDBC URL. When a thread executing a JSP instance requires a database connection, it obtains it from the pool manager. Once the thread has finished using the connection it is returned to the pool. The pool manager will then handle the connection immediately to one of the blocked requests.

67. The option (c) above has many advantages. Therefore, in an advanced version of the system, a JDBC Pooling and SQL caching module (e.g., PoolMan from CodeStudio) may also be added (see annex C for the results of a benchmark test carried out using the prototype).

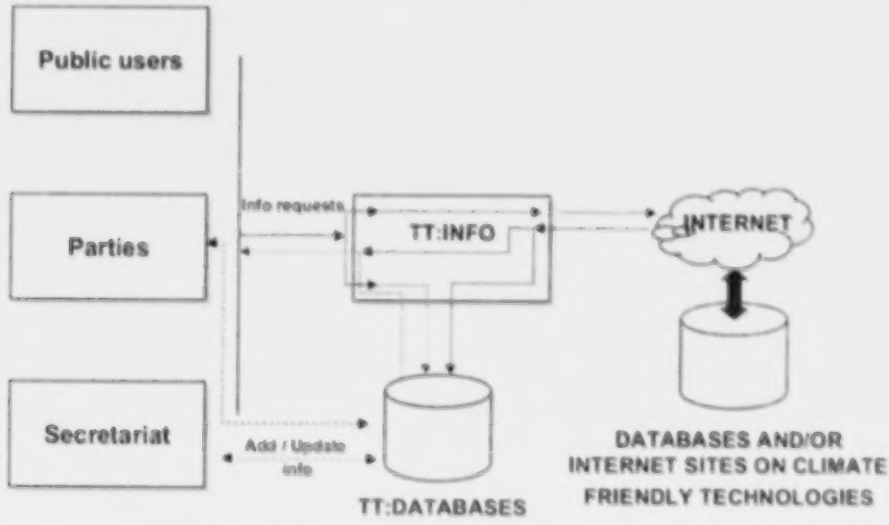


Figure VI.4. Access to the local and external databases

68. The access to dynamic web pages is illustrated in figure VI.4. An HTTP information request, made by a client using a web browser, is intercepted by TT:INFO. The following cases are possible:

(a) The request relates to information from local databases. In this case TT:INFO will query these databases, will generate the HTML pages corresponding to the query result, and will send the answer back to the user.

(b) The request relates to information from external databases. In this case TT:INFO will convert the query in the format specific to the external site (such as GEF projects map, IEA CADDET) and will pass it to the corresponding site through the Internet. The external site will process the request for information, using its query system, and will send an HTML back to TT:INFO. The answer from the external site will be parsed to extract the information needed

from the HTML page. This information will then be used to update some back-up local databases and to generate an HTML page, which will be sent to the user.

(c) The request relates to information from local and external databases. In this case points (a) and (b) above will be executed and the results will be consolidated into one dynamic HTML page which will be sent to the user.

69. The main advantages of the proposed software architecture are (a) portability (the programming language used may be ported to all main operating systems), (b) based on the open source movement (access to source codes of the products used and to the open sources programmers), and (c) reduced costs (all the products are available free of change or already exist in the UNFCCC). Some other technical details relating to this approach are given in annex L.

70. Of course, a decision on the information technology to be used in implementing the project has to take into consideration many other aspects such as competing technologies (such as Microsoft's Active Server Pages – ASP, PHP scripts, XML), future of the open source movement, future of major players in the field (such as Microsoft, Oracle, IBM, Sun Microsystems), and so on. Other aspects such as the organization's IT, standards and procedure, security policy, version control, bug tracking, source control and others will also have to be addressed.

C. Methods for technology assessment and comparison

71. In the second phase of the proposed project a set of tools for technology assessment and comparison (TT:TOOLS), to be used in combination with the TT:DATABASES and TT:IIS, will be designed, tested and disseminated. The tools will be used for performing simple sensitivity analysis on capabilities and limitations of different technologies, taking local conditions into consideration and to perform comparisons of different technological options conducive to mitigating and or adapting to climate change. The relation between these tools and the rest of the system is illustrated in figure VI.5. The figure also shows the two types of tools considered: (a) analytical and (b) decision support.

72. The **analytical modules** can either be of general use, regardless of the technology type, or have specific use, valid only for one technology type. These modules, together with some key parameters to be provided by the user, will allow for estimation of aggregated parameters such as averaged costs, full technology chain GHG emissions and others.

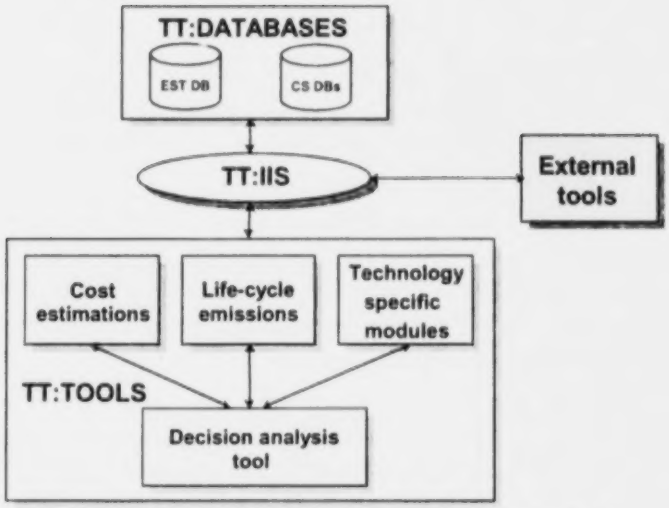


Figure VI.5. The modular structure of TT:TOOLS

73. In a real situation, the users of the system will also be interested in comparing the different technological options in terms of their costs and environmental performances. These comparisons can range from simple side-by-side comparison of the basic data to more complex multicriteria comparisons using a decision analysis tool. As the effects of global warming are still uncertain, **decision analysis tools,** which can operate with uncertainties, will be recommended.

74. Many such tools are already available. Therefore, background information on the main characteristics and capabilities of a number of selected computer tools for technology assessment and comparison may prove useful for developing countries. TT:CLEAR may be used to create such an inventory by stimulating the developers of these tools to register them in the system and provide electronically some information on their main characteristics. Furthermore, in order to limit the scope of the inventory some selection criteria can be used. For example, these criteria may include:

(a) They address the main elements of comparative assessment of different climate friendly technologies, in particular from environmental and economic standpoint;

(b) They are available at low or no cost;

(c) They run on personal computers (PCs);

(d) Training can be provided in their use.

75. The decision on what modules to develop and implement will be made later. However, for illustrative purposes, some considerations on the life-cycle emissions module are presented below.

Figure VI.6. Full technology chains for electricity supply technologies

76. It is generally agreed that consideration of GHG releases at the operation level of a technology only (for example, at power plant level for an electricity generating technology chain) could be misleading. Although for some technology chains, such as those for electricity generation using solid fuels (see annex K figure K.3), the power plant is the major source of GHG emissions, for other technology chains, the mining, transportation and construction or dismantling stages are more important emitters (for example, methane losses during transportation of natural gas, emissions associated with the production of the materials used in solar cells or hydro dams). Therefore, some analytical capabilities are needed to estimate the full technology chain GHGs. For illustrative purposes, a type of methodology which may be used to implement the module, based on a simplified life cycle approach, is presented in annex K.

77. The diagrams presented in figure VI.5 may also be used to provide a classification of the technologies and for accessing information; they indicate the technology coverage by EST DB.

VII. TECHNOLOGY TRANSFER INTERNATIONAL INFORMATION NETWORK

78. The proposed structure of the international information network consists of the main collaborating information centre, the clearing house, with a number of international, regional and national focal points. The network's components can be connected in a hierarchical structure (figure VII.1) or in a true network structure (figure VII.2). The true network structure offers greater flexibility and is less expensive to implement, which makes it the preferred choice.

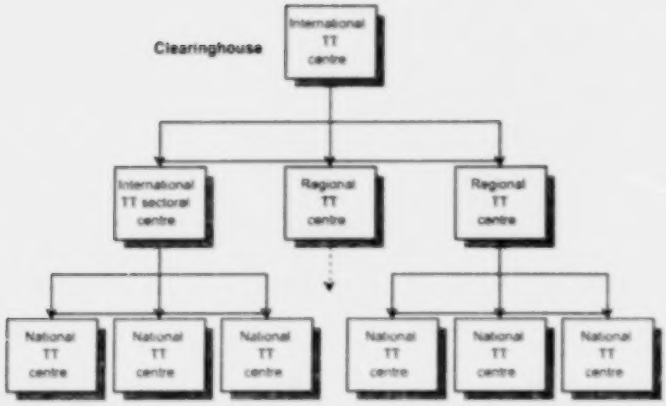


Figure VII.1. Hierarchical structure of the information network

79. These focal points may be chosen from the network of existing institutional capacity and expertise in specific/priority mitigation and adaptation areas.

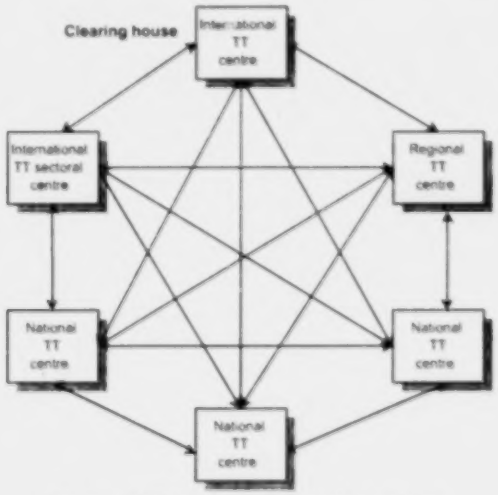


Figure VII.2. True network structure

80. Considerable institutional capacity to provide information systems in support of the transfer of environmentally sound technologies and know-how already exists. Much of this capacity is distributed among relevant United Nations organizations and specialized agencies, and the national and regional networks which they serve. Enhancing coordination among these organizations by involving them in the proposed network would deliver considerable benefits to all Parties at moderately low cost. Such cooperation, particularly through the establishing of focal points, would make Parties' access to information on ESTs and technology transfer projects much easier.

81. A possible arrangement for focal points and sectoral coverage by different international organizations is shown in table VII.3.

Table VII.1. International organizations: sectoral coverage and collaboration

Organization	Proposed 'in house' sectoral coverage	Proposed specific collaboration partnership
Food and Agriculture Organization (FAO)	Agricultural focal point	
UNEP-Industry and Environment	Environmentally sustainable technologies for industry projects and processes with particular focus on mitigation technologies	International Environmental Technology Centre (Japan) focusing on environmentally sound technologies for urban and freshwater management
		UNEP- RISO Collaborating Centre on Energy and Environment (according to expertise)
	Waste management	Tata Energy Research Institute (India) (according to expertise)
UNIDO	Focal point for industry-related activities directed at reducing industrial GHGs	UNIDO (Cleaner Production Centres programme)
World Health Organization (WHO)	Health focal point	Inter-Agency Network on Climate and Human comprising WMO, UNEP and FAO (tentatively)
Word Meteorological Organization (WMO)	Hydrological and agricultural focal point (others could be considered)	FAO, UNEP, United Nations Educational, Scientific and Cultural Organization (UNESCO) and International Agricultural Research Centres under the Consultative Group on International Agricultural Research system

82. A first step in implementing the network will be, following the prior discussions with these institutions on the subject matter, to seek their agreement in participating in the project and to formalize the cooperation through a letter of understanding. The letter should contain the objectives of the work, work procedures, responsibilities and methods of sharing the results.

83. The next step will be to establish a management mechanism with participation from institutions engaged in the technology transfer field. Several institutions currently have a large amount of relevant and useful information posted on their web sites, with new information being added continuously. By including these institutions as a sort of "steering committee" for the clearing house and sectoral centres, we may be able more effectively to update the site with a vast array of additional information to enhance the availability of climate technology resources. The proposal for the development of a steering committee includes the following tasks:
To identify possible institutions (and individuals) to take part in the steering committee. The structure should represent all interested parties (international organizations, regional centres and users, for example);

(a) To hold a meeting with possible steering committee members to discuss the opportunity, possible responsibilities and a steering committee meeting schedule;

(b) To hold one or two meetings per year to discuss updates and additions to the project.

(c) To hold one or two meetings per year to discuss updates and additions to the project.

84. The expert group on technology transfer anticipated in decision -/CP.6 on development and transfer of technologies, forwarded for adoption by the COP at its seventh session (FCCC/CP/2001/5/Add.1), will play a leading role in establishing and managing the network.

VIII. DETAILED ESTIMATES OF RESOURCE IMPLICATIONS

85. A functional prototype of the clearing house has been developed within the present budget constraints of the Technology Subprogramme of the UNFCCC. However, implementation of the first phase of the project will require additional resources. Tentative estimates of the manpower resource implications, by task, is provided in table VIII.1.

Table VIII.1. TT:CLEAR resource implications for Phase I (a and b) and II

Task	Priority[19]	Resources required[20]	Actors
PHASE I			
1. Consoliding present work			
Integrating ICF and secretariat sites	H	3 weeks programming/consulting	secretariat, ICF
2. Establishing TTProjects DB			
Redesigning and implementing	H	1-2 weeks programming/consulting	secretariat
Updating	H	2-3 months (1 month secretariat)	secretariat, Parties
Peer review	M	3-6 month	Parties
3. Establishing EST DB			
Designing and implementing	M	2 weeks	secretariat, consultant
Data gathering and introduction	M	continuous	secretariat, Parties
Updating (existing data) and consistency checking and validation	M	1 month	secretariat, consultant
Peer review	M	3-4 months including expert meeting(s)	Parties, experts
4. Establishing TTNeeds DB			
Designing and implementing	H	2 weeks	secretariat, consultant
Data gathering and introduction	H	4-5 months (1 month secretariat)	Parties, secretariat
Consistency checking (peer review)	M	2 weeks	Parties
5. Establishing auxiliary databases			
Regional and national centres database	H	2 weeks	secretariat, ICF
Experts database	H	2 weeks	secretariat
Links to resources	H	1 month	secretariat, consultant

[19] H- High, M – Medium, L – Low.

[20] The resources needed to peer review the databases by Parties are not included in the estimated budget.

Task	Priority[29]	Resources required[30]	Actors
6. TT:IIS			
(a) Data entering module	M	1 month	secretariat, consultant, selected Parties
(b) News module	H	3 weeks	secretariat, consultant, selected Parties
(c) TT Network connection module	L	1 month	secretariat, consultant, selected Parties
(d) Linking module	H	1 month	secretariat, consultant, selected Parties
(e) Negotiations module	H	2 weeks	secretariat, consultant, selected Parties
(f) Query and search module	H	1-2 months	secretariat, consultant, selected Parties
(g) Matching module	M	1 month	secretariat, consultant, selected Parties
(h) Assistance module	H	1 month	secretariat, consultant, selected Parties
(i) Capacity-building module	L	1 month	secretariat, consultant, selected Parties
(j) System management module	H	2 months	secretariat, consultant, selected Parties
(k) Tools interface module	L	2-3 weeks	secretariat, consultant, selected Parties
PHASE II			
7. TT:TOOLS			
Levelized costs	L	3 weeks	to be decided later
Full technology chain GHG emissions	L	1 month	to be decided later
Technology specific modules	L	2-3 months	to be decided later
Decision analysis module	L	2 months	to be decided later
8. Case studies	L	4-6 months	after the system is operational
9. Dissemination	L-M	6 months	may be started after the first phase
PHASE I AND II			
10. Expert meetings	H	2-3 meetings (8-10 supported participants)	secretariat, Parties
11. Cooperation with other international organizations	H	continuous (may involve travel)	secretariat, other IGOs

IX. MONITORING AND EVALUATION PLAN

86. The following milestones are suggested for monitoring progress and performances of the project.

(a) TT:CLEAR full featured prototype set-up and testing completed;

(b) Efficient sharing of information with major actors involved in the transfer of environmentally sound technologies;

(c) The clearing house is used by parties to introduce and maintain on-line projects and activities relating to development and transfer of technologies;

(d) At least three regional technology transfer support centres, one for each United Nation geographical groups in Asia, Latin America and Africa linked to TT:CLEAR.

87. After the initial testing and implementation period a continuous and thorough monitoring of the impact of the system on improving the transfer of technologies should be conducted. The following indicators for success are proposed for performance monitoring beyond the testing period:

(a) Quality of information accessible through the clearing house;

(b) Number and distribution of regional and national technology transfer support centres linked to TT:CLEAR;

(c) Number of hits and log-ins per month. Number of registered users. Number of specific services requested and number of users reached with these services;

(d) Quality of synthesis information prepared using the system;

(e) Nature, quality and quantity of the generated global benefits.

88. A detailed Monitoring and Evaluation Plan, considering the above indicators, will be developed during the testing period of the project and submitted to the SBSTA for approval.

X. FUNCTIONAL PROTOTYPE

A. General characteristics

89. The prototype may be used to access information on ongoing technology cooperation projects by countries, sectors of activity or technology type, to browse technical characteristics, economic performance and environmental parameters of different technologies, to locate possible partners or to locate experts to provide support. They may also perform side-by-side comparisons of different technologies stored in the database.

90. The beta version of the functional prototype is designed to complement and work with existing web sites/clearing houses of other relevant international organizations and national/regional technology information centres. It has the potential to act as a gateway for fast access to up-to-date information on the latest technology transfer projects, environmentally sound technologies and know-how, and organizations and experts involved in the development and transfer of technologies.

91. The prototype is available to the Parties for testing. To access the prototype, open your Internet browser and type in the TT:CLEAR address (http://ttclear.unfccc.com/ttclear/Jsp). The log-in page will be displayed (figure X. 1). Before entering the system, you need to register. Click on "Join the TTClear" hyperlink or click on the "Join Now!" graphic and fill in the registration form.[21]

Login to TTClear - Microsoft Internet Explorer provided by SoftQuad Software Inc.
File Edit View Favorites Tools Help
© UNFCCC 2000-2001
Welcome to TTClear
The technology transfer information clearing house (TTClear) is a prototype site* aiming at promoting the transfer of environmentally sound technologies under the United Nations Framework Convention for Climate Change.
Login :
Password:
Login
Reset
Join Now !
Join the TTClear - You will be requested to fill in the registration form for access to the TTClear pages

Figure X.1 Log-in page

92. The home page (figure X.1) is the central point of access to TT:CLEAR. It has a flexible and user-friendly interface which contains three areas (frames): the menus and banner area ("a" in figure X.2), the navigation or table of content area ("b" in figure X.2) and the information display area ("c" in figure X.2). Some characteristics of these areas are as follows:

(a) The menu and banner area contains a global menu, which connects TT:CLEAR to the main UNFCCC site, a local menu, which connects the site to the science and technology web pages and/or provides fast access to some TT:CLEAR pages, and a banner. Drop-down lists of sub-menus are displayed when the mouse pointer is positioned over menu elements[22]. The banner area, located between the main and local menus, may contain different advertisements. In the present version of the software this area is blank.

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[21] During the testing period, your password has to be activated by the UNFCCC. This will introduce some delays and you will not be able to access the system immediately after registration. You will receive an e-mail from the UNFCCC to indicate that you can start to use the system.

[22] This feature is currently supported only by Internet Explorer. In other browsers, the sub-menus will not be displayed.

(b) The left-hand side navigation area contains a tree-like menu, which expands or collapses as you click on its nodes. To access a page, expand the tree to the desired level and click on the corresponding name or the icon. The navigation area also contains a drop-down list and a button for quick links to main web sites relating to development and transfer of climate-friendly technologies.

(c) The information display area is used to show information pages from the web site. The information in this area can be printed separately.

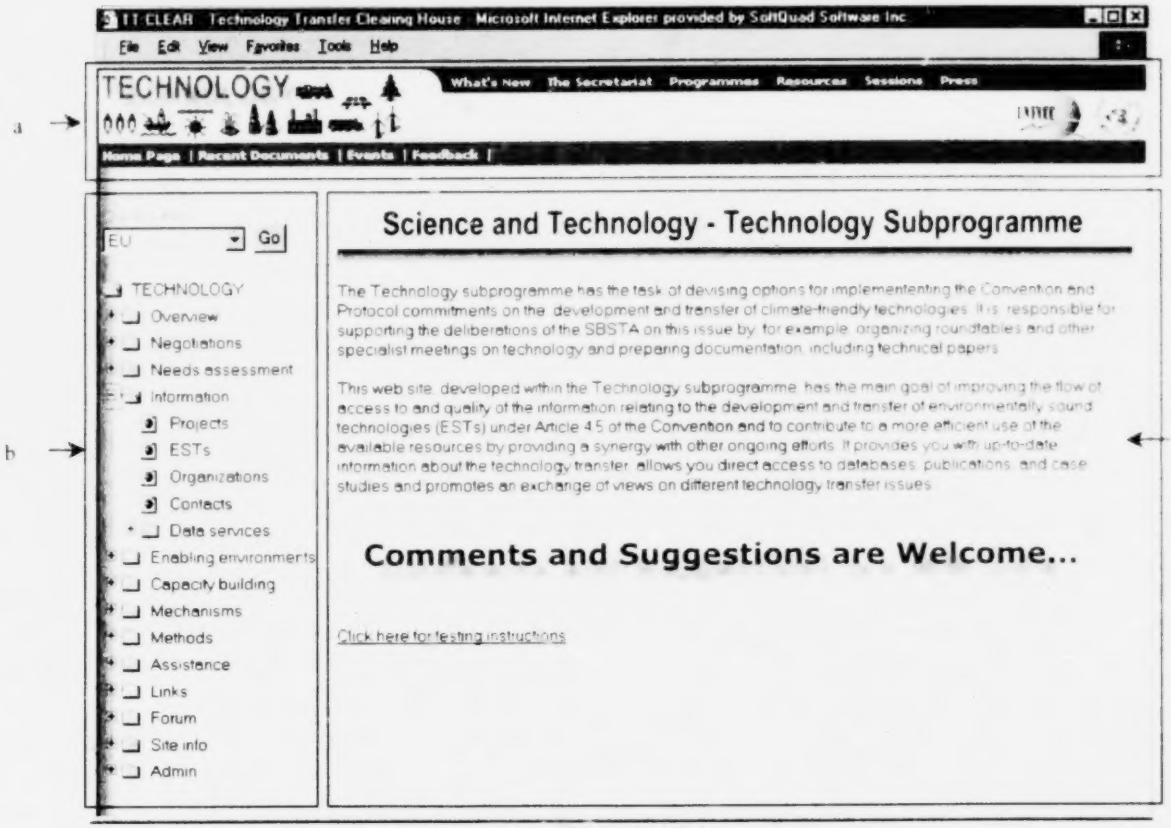
a
b
c
TT:CLEAR Technology Transfer Clearing House - Microsoft Internet Explorer provided by SoftQuad Software Inc.
File Edit View Favorites Tools Help
TECHNOLOGY
What's New The Secretariat Programmes Resources Sessions Press
Home Page | Recent Documents | Events | Feedback |
EU
Go
TECHNOLOGY
Overview
Negotiations
Needs assessment
Information
Projects
ESTs
Organizations
Contacts
Data services
Enabling environments
Capacity building
Mechanisms
Methods
Assistance
Links
Forum
Site info
Admin
Science and Technology - Technology Subprogramme
The Technology subprogramme has the task of devising options for implementing the Convention and Protocol commitments on the development and transfer of climate-friendly technologies. It is responsible for supporting the deliberations of the SBSTA on this issue by, for example, organizing roundtables and other specialist meetings on technology and preparing documentation, including technical papers.
This web site, developed within the Technology subprogramme, has the main goal of improving the flow of access to and quality of the information relating to the development and transfer of environmentally sound technologies (ESTs) under Article 4.5 of the Convention and to contribute to a more efficient use of the available resources by providing a synergy with other ongoing efforts. It provides you with up-to-date information about the technology transfer, allows you direct access to databases, publications, and case studies and promotes an exchange of views on different technology transfer issues.
Comments and Suggestions are Welcome...
Click here for testing instructions

Figure X.2: TT:CLEAR home page

Site	Menus																					Table X.1
Cleaner Production Germany (CPG)	Technology	Industries	Addresses	Promotion	Trends	Int. Coop	Environmental management	About CPG	Search	E-mail	FAQ	Sitemap	Partners	Current								
China - ESTs	Services	Publications	Events	Projects		Programme							Membership									
maESTro								What is				Sitemap	Contributors		Download	Contact us	Disclaimer	Help				
NEDO	Activities							Introd NEDO											Links			
CTI	CTI Awards	Publications	Calendar	CTI Forum	Conferences			About CTI	Search				Partners	News		Contact us			Links			
CADDET	MyCADDET Profile My news	New publications	Upcoming events	E-mail service	Products and tools EE Toolkit Links Latest products Product overview Ordering	Network Country contacts Cooperation Other IEA centres			Search Database		FAQ	Sitemap		News Desk		Contact us				Feedback	Copyright
CADDET-RE	Technologies	Technical brochures	Events		Newsletter				Search					News		Contact us			International Atomic Energy Agency Links Other Links	Feedback	Register product online
Greentie	Database Search Registration Classification Help Tips Tutorial	Products Directory CD-ROM Newsletter	News desk News online Events Publications E-mail news			Network GREENTIE Offices worldwide Cooperation													Links Technology info Info organizations Funding organizations	Feedback User survey Comments suggestions	Copyright
CH Bio	Activities Scinet and tech. Coop Technology transfer Information exchange Research cooperation Documents Meetings Independent review Partnership NFP-CHM	informal advisory committee Mandate Members Meetings	Regional workshops Latin America Central and East Europe Asia Africa	Synergies GPA-CHM GEF																		

93. In the prototype the local menu and table of contents of the are not yet finalized and will be modified to reflect the feedback expected to be received during the testing period and the implementation of other TT.IIS modules. For example new menus such as "Search" (general site search), "News", "Contact Us", "Partners", "FAQ", and "About TTCLEAR" are being considered for addition. The existing and proposed menus can be compared with the main menus of several relevant web sites and clearing houses, presented in table X.1.

B. Query and search and data-entering modules

94. The prototype includes a search engine which enables users to access distributed sources of information such as the UNFCCC, the Organization for Economic Cooperation and Developments (OECD), IEA and United Nation Environment Programme (UNEP) databases[23], performs conversions between different classifications used by these sources, and presents consolidated results. To access the search engine, click on the "Information" folder in the table of contents. The list will expand with sub-folders labelled Projects, ESTs, Organizations, and Contacts (figure X. 2).

95. The technology cooperation projects search engine is shown in figure X.3. To perform a search, click on the check boxes of the databases to search and use the drop-down lists and/or ratio buttons to specify additional search criteria (middle part of the page). Some characteristics of the projects search engine are as follows:

(a) It allows a search to be made by using global criteria such as donor country, recipient country, implementing agency and text strings in the project title or project description;

(b) It enables the user to specify local criteria when searching each database. For example:

- The UNFCCC Technology Transfer Projects database allows project searches to be made using the following criteria: project type (such as mitigation, adaptation), project status (such as ongoing, completed, cancelled), project elements (such as investment facilitation, regulatory/technical barrier removal, demonstration project) and source of information;
- The GEF database allows searches to be made using the following criteria: focal area, project type, operational program and funding amount. The focal are criteria is restricted to climate change;
- The OECD/DAC database can be searched using other criteria: sector of the aid (e.g. energy generation and supply, transport, industry, agriculture and forestry), the policy objectives of the aid (these objectives are tracked across most sectors and forms of aid using a "marker system") and the nature or form of the aid (such as grants, loans, technical cooperation);
- The IEA CADDET database allows project searches to be made using criteria such as economic sectors and sub-sectors;

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[23] In the prototype the link to the UNEP-maESTro database is not yet implemented.

- The prototype UNFCCC capacity-building activities database allows searches to be made by "topics" and "criteria".

96. The interface of the project search engine can be simplified further by combining some local criteria into global criteria. This may be accomplished by harmonizing the classifications used by local and external databases.

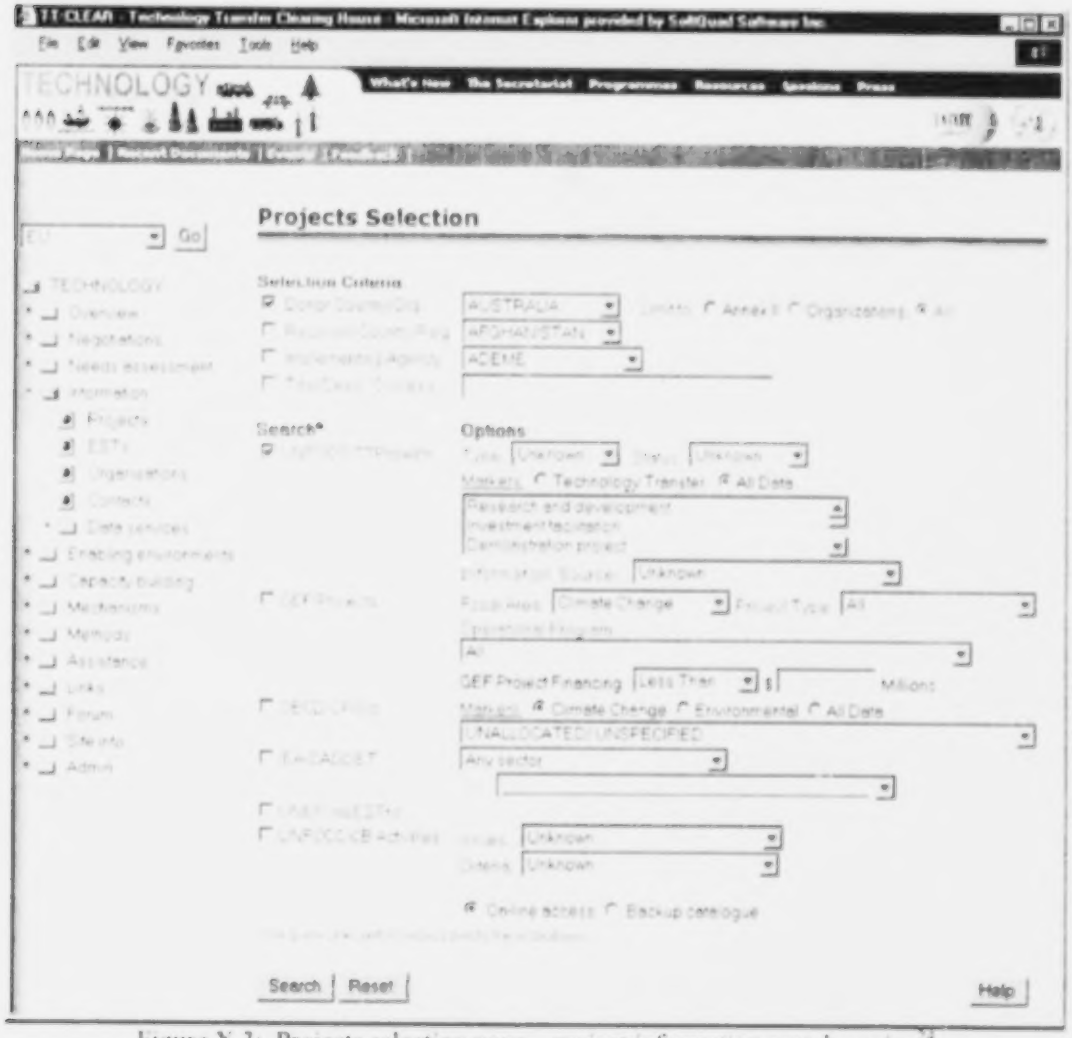

Figure X.3: Projects selection page – project information search engine[24]

[24] If no search criteria are imposed, then the full content of the selected database will be displayed (e.g. deselect the Donor Country Org. check box, leave UNFCCC-TTProjects selected and click the "Search" button). By default the Internet is used to access and query on-line external databases (e.g. GEF, CADDET, Greentie). To use the local back-up catalogue change the ratio button from "On-line access" to "Back-up catalogue".

97. The Donor Country list also includes, at the bottom, donor organizations such as multilateral development banks and national development agencies. The recipient country list includes names of geographical regions for regional projects. The region names are used only when the names of the recipient countries are unknown.

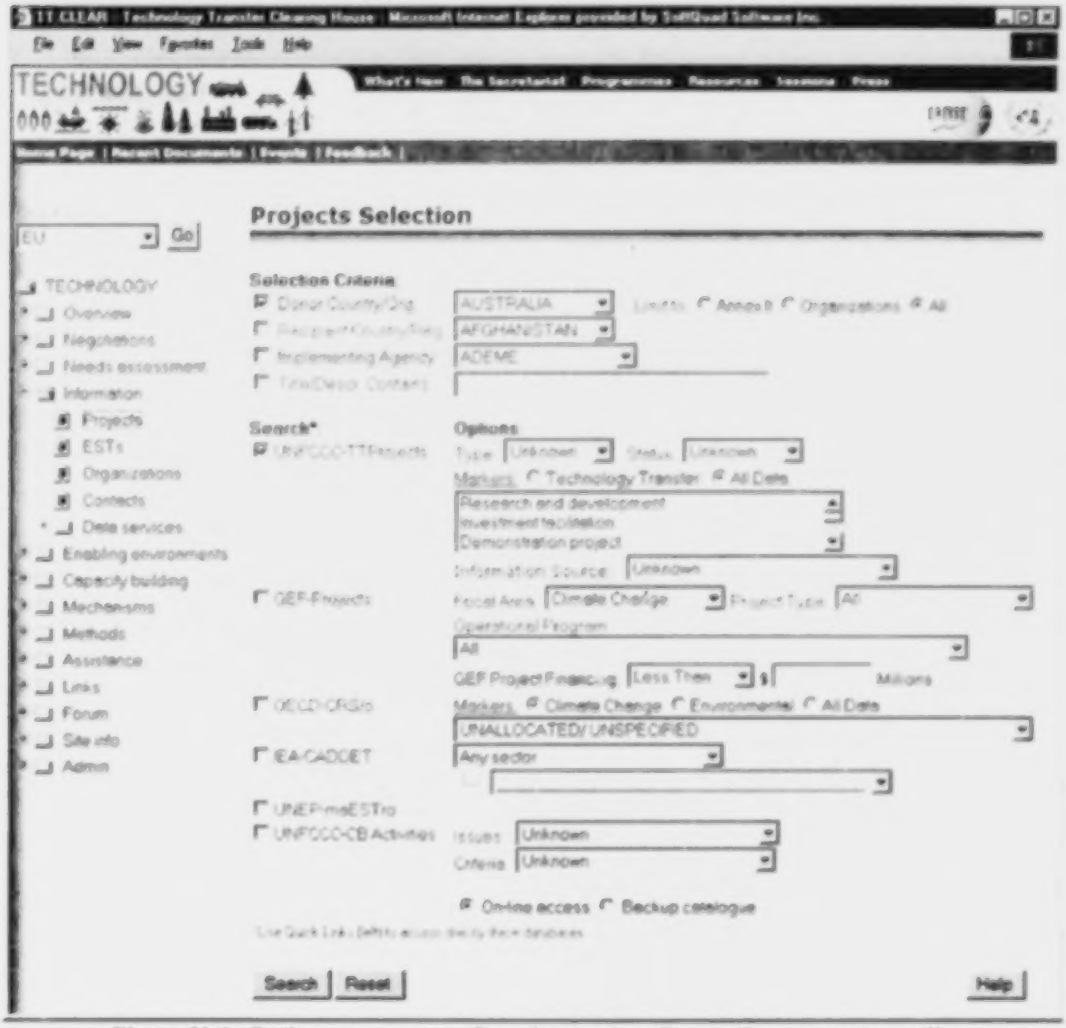

Figure X.4: Projects summary – Search criterion: Donor Country = Australia

98. The summary list of projects satisfying the selected search criteria, corresponding to figure X.3, is shown in figure X.4. The page contains the selection criterion (Donor Country = Australia) and a list of project numbers, icons (indicating the database from which the information was extracted), and project names. At the bottom, the page contains the "Add" button, a legend and a disclaimer.

99. To add a project click the "Add" button. A blank data introduction form, similar to that shown in X.6, will be displayed. Fill in the form and click the "Add" button. Note that only Parties and secretariat staff can add new projects into the local databases.

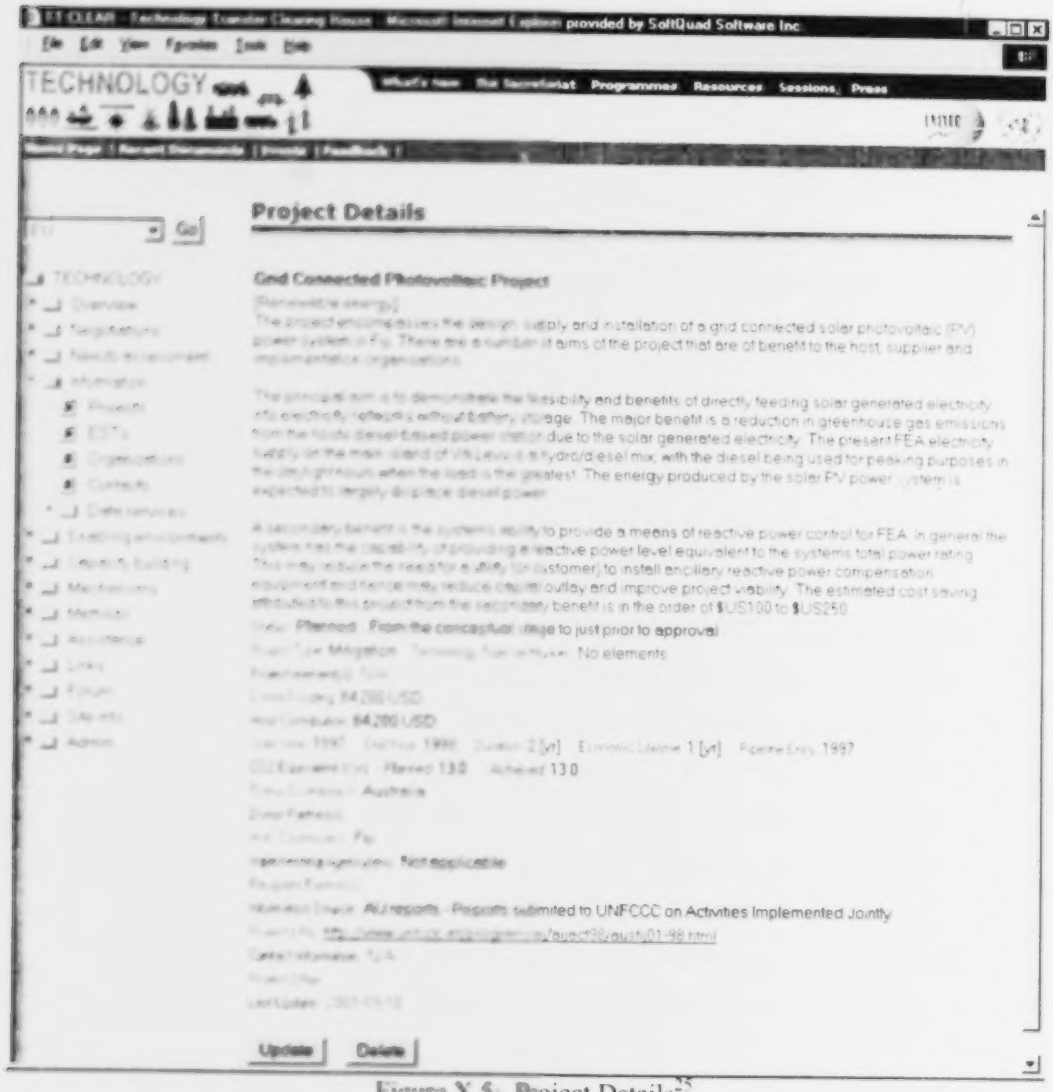

Figure X.5: Project Details[25]

100. Detailed project information can be accessed by clicking on the corresponding project number in the list (figure X. 4). The details include: the project name, description, status, type, technology marker, elements, donor funding, host contribution, start year, end year, economic

[25] For public users "Update" and "Delete" buttons will not be included in this page. For Parties the "Delete" button will not be available. It is faster to use the browser's "Back" button to go the "Project Selection" page than to access it from the table of contents frame followed by a new search.

lifetime, pipeline registration year, CO_2 reduction (planned and achieved), donor country and partner, host country and partner, implementing agency, source of information, project URL, contact person, project officer and the date of last update.

101. Although several new fields have been added in the beta version of the prototype, some information is still missing. Most notably, the classification of the projects by technology and economic sector should be added.

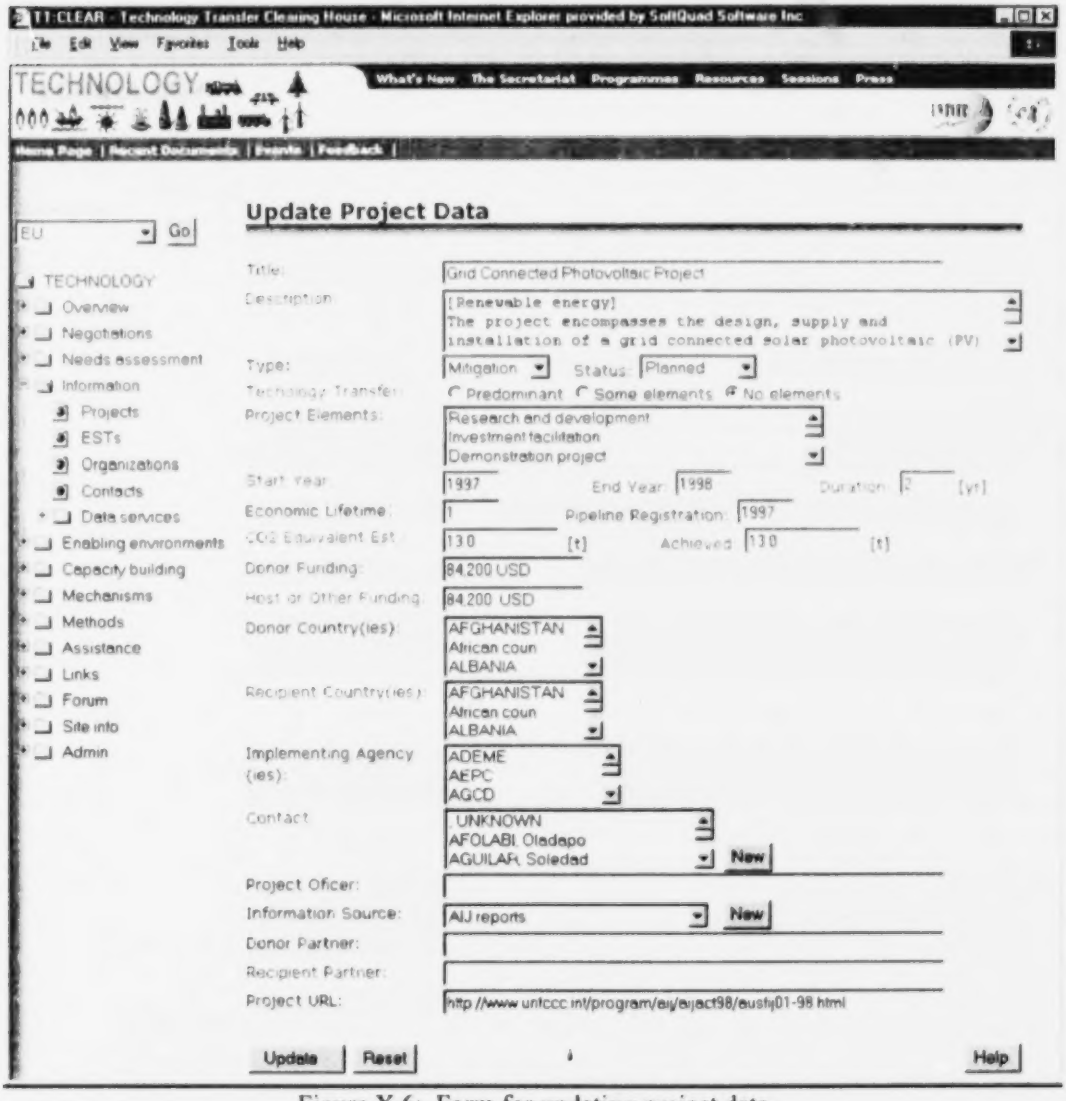
TT:CLEAR - Technology Transfer Clearing House - Microsoft Internet Explorer provided by SoftQuad Software Inc.
File Edit View Favorites Tools Help
TECHNOLOGY
What's New The Secretariat Programmes Resources Sessions Press
Home Page | Recent Documents | Search | Feedback
EU Go
TECHNOLOGY
Overview
Negotiations
Needs assessment
Information
Projects
ESTs
Organizations
Contacts
Data services
Enabling environments
Capacity building
Mechanisms
Methods
Assistance
Links
Forum
Site info
Admin
Update Project Data
Title: Grid Connected Photovoltaic Project
Description: [Renewable energy] The project encompasses the design, supply and installation of a grid connected solar photovoltaic (PV)
Type: Mitigation Status: Planned
Technology Transfer: Predominant Some elements No elements
Project Elements: Research and development; Investment facilitation; Demonstration project
Start Year: 1997 End Year: 1998 Duration: 2 [yr]
Economic Lifetime: 1 Pipeline Registration: 1997
CO2 Equivalent Est: 130 [t] Achieved: 130 [t]
Donor Funding: 84,200 USD
Host or Other Funding: 84,200 USD
Donor Country(ies): AFGHANISTAN; African coun; ALBANIA
Recipient Country(ies): AFGHANISTAN; African coun; ALBANIA
Implementing Agency (ies): ADEME; AEPC; AGCD
Contact: UNKNOWN; AFOLABI, Oladapo; AGUILAR, Soledad New
Project Oficer:
Information Source: AIJ reports New
Donor Partner:
Recipient Partner:
Project URL: http://www.unfccc.int/program/aij/aijact98/austly01-98.html
Update Reset Help

Figure X.6: Form for updating project data

102. Use the "Update" button, in the "Project Details" page, to update project data (figure X. 6). Make the modifications and click the "Update" button again. After you make modifications, to display them, go "Back" to "Project Details", right click on the main frame and

select "Refresh" to update the information. Please note that the modifications will be written to the database immediately and the rollback options are not implemented in the prototype.

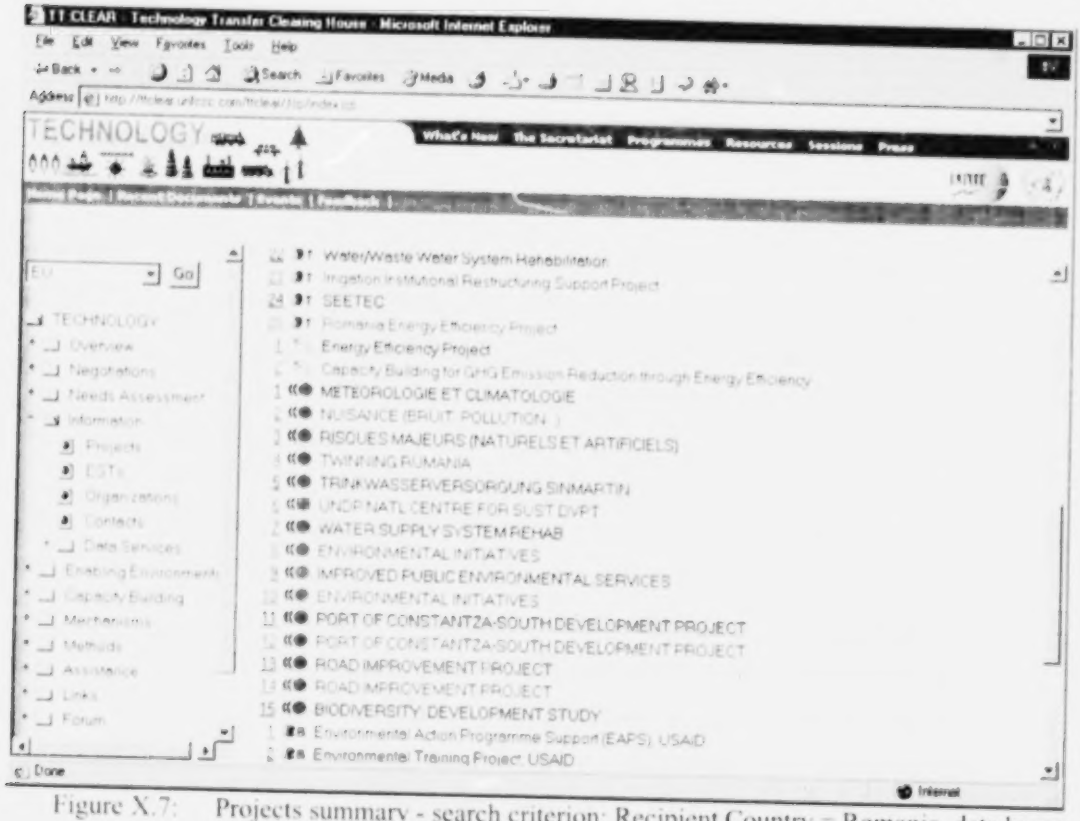

Figure X.7: Projects summary - search criterion: Recipient Country = Romania, data bases searched: TTProjects, GEF, OECD/DAC (environment marker) and TT CB Activities

103. Figure X. 7 illustrates the consolidated list of projects obtained by searching several databases. Icons are used to indicate the source of information for each project. To access detailed project data click on the corresponding project number in the list.

104. The project details page is different for each database. For the external projects the system will access the detail page on the remote web site directly. Figure X. 8 illustrates the project details corresponding to the first GEF project in the above figure. Figure X. 9 illustrates the project details for the OECD/DAC project number eight in the above figure.

105. In some cases, the detailed data of external projects do not include information such as classifications used by the UNFCCC or markers for technology transfer. In this case, data can be stored and maintained locally for these projects (figure X. 9 – "Update Local Data" button).

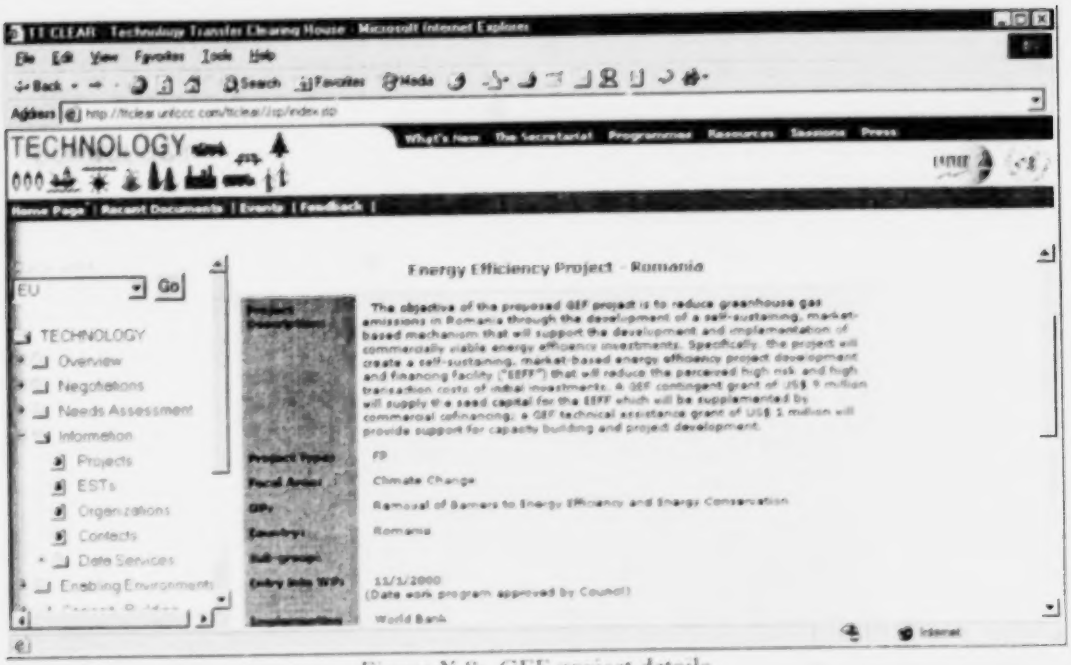

Figure X.8: GEF project details

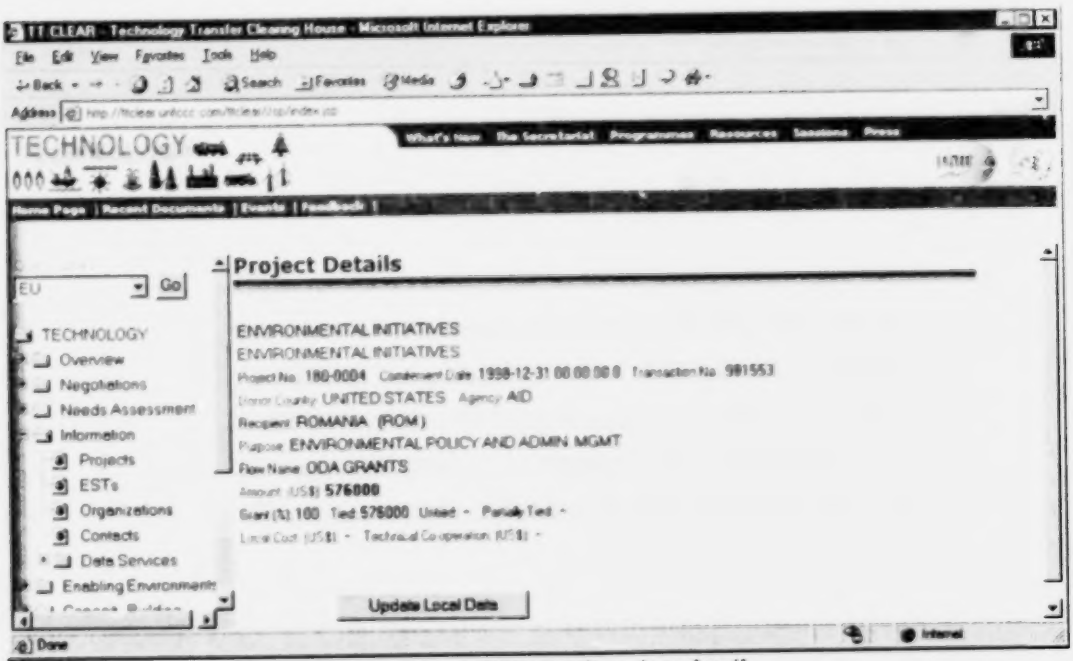

Figure X.9: OECD/DAC project details

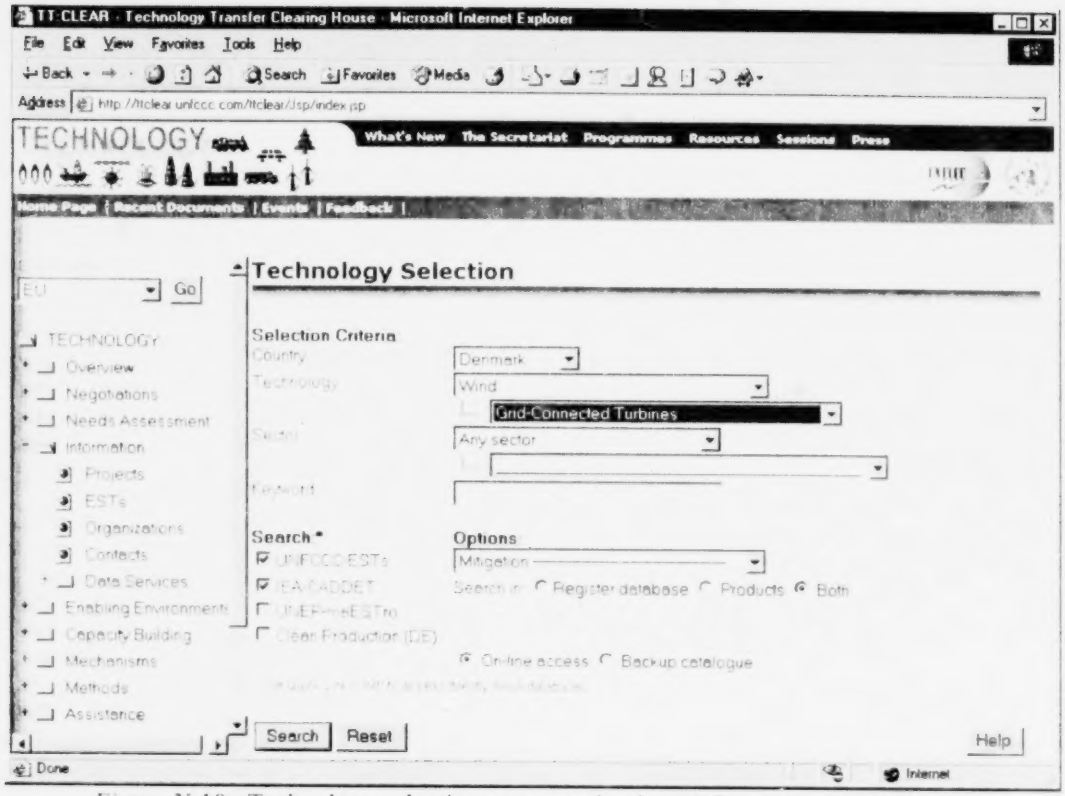

Figure X.10: Technology selection page – technology information search engine

106. Similar search engines are available to access information on environmentally sound technologies (figure X. 10), organizations and institutions involved in technology transfer and experts contacts (figure X. 11).

107. The technology search engine allows the user to perform searches on the UNFCC ESTs database (limited to energy supply technologies) and IEA – CADDET energy efficiency demonstration projects. Links to other databases, such as the UNEP- maESTro and Cleaner Production Germany are under development.

108. The contacts search engine retrieves information from the UNFCCC roster of experts and from the TT Contacts database. The search criteria include products or services and areas of expertise by discipline and technology type (mitigation and adaptation). The TT Contacts database can be searched only by categories of experts (e.g., Friends of the Chair, clearing house, coastal zone centres, technology information centres).

109. For illustrative purposes, the result of a search for Friends of the Chair in TT Contacts is shown in figure X.12.

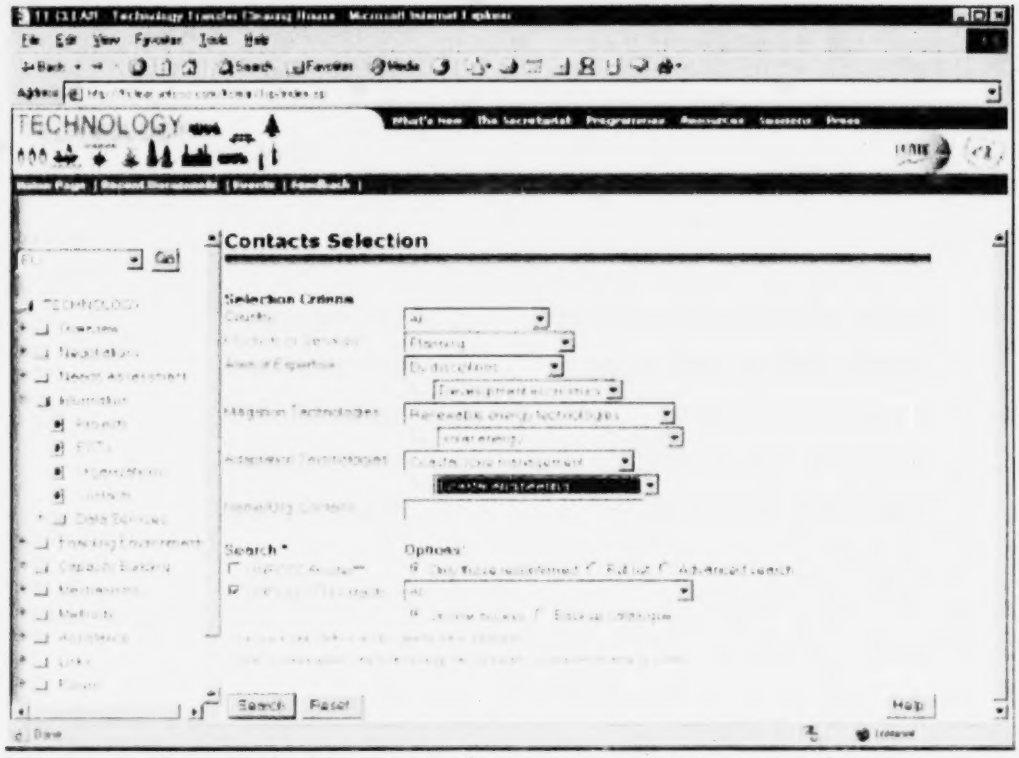

Figure X.11: Contacts selection page – experts/contacts search engine

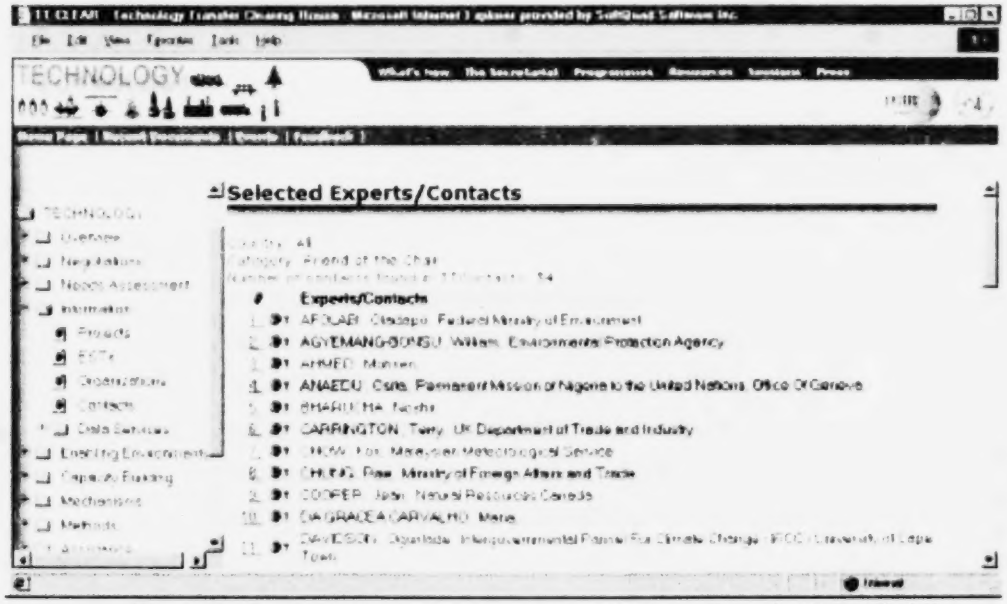

Figure X.12: Contacts summary – search criterion: "Friends of the Chair"

C. Linking module

110. The prototype includes a linking module, which allows access to external web sites relating to climate change and technology transfer. To access this module, click the "Link" folder in the left-hand side table of contents.

111. The web site's search engine is shown in figure X.13. To perform a search, click on the drop-down lists, select the search criteria (fields of activity) and click the "Search" button. The classification of the web sites is preliminary and it was organized according to the fields of activity presented in appendix H.

112. The information on external web sites is stored in a local database, which was created by collecting and classifying information for the Internet. However, as this information may change rapidly:

(a) Capabilities should be added to allow Parties to register information on relevant national web sites and update them on-line;

(b) An automated procedure should be designed to search and categorize web sites. The procedure may use existing search engines such as Google or a specially designed web spider;

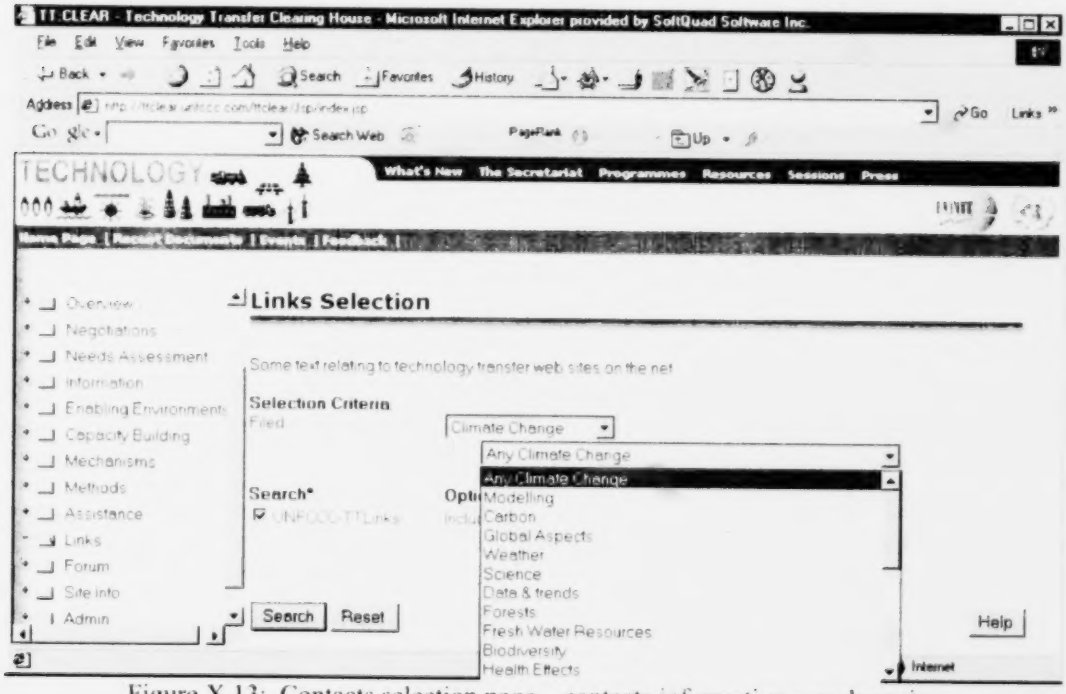

Figure X.13: Contacts selection page – contacts information search engine

113. For illustrative purposes, figure X.14 presents the results obtained by searching the database of links for government web sites, which disseminate energy-related information. The list includes names and short descriptions of the sites.

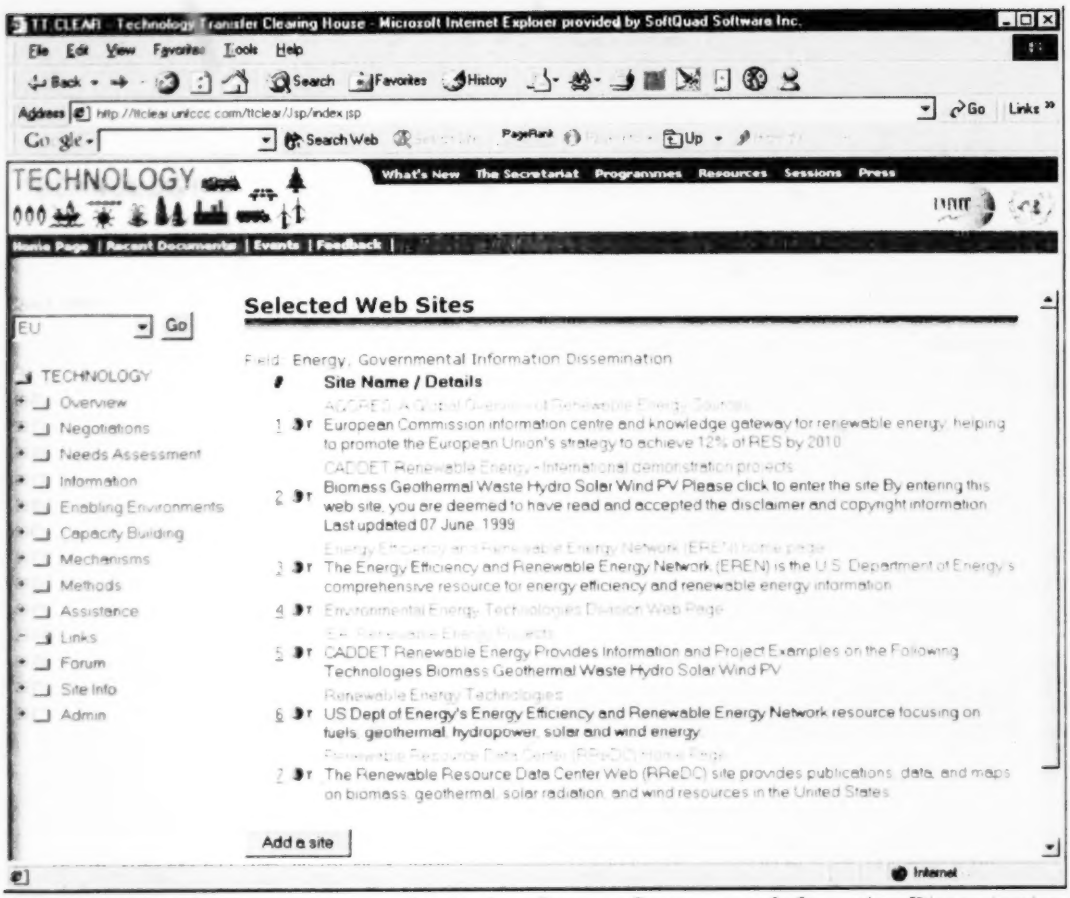
TT:CLEAR - Technology Transfer Clearing House - Microsoft Internet Explorer provided by SoftQuad Software Inc.
File Edit View Favorites Tools Help
Back Search Favorites History
Address http://ttclear.unfccc.com/ttclear//jsp/index.jsp
Go Links
Search Web
TECHNOLOGY
What's New The Secretariat Programmes Resources Sessions Press
Home Page | Recent Documents | Events | Feedback |
EU Go
TECHNOLOGY
Overview
Negotiations
Needs Assessment
Information
Enabling Environments
Capacity Building
Mechanisms
Methods
Assistance
Links
Forum
Site Info
Admin
Selected Web Sites
Field: Energy, Governmental Information Dissemination
Site Name / Details
1 European Commission information centre and knowledge gateway for renewable energy, helping to promote the European Union's strategy to achieve 12% of RES by 2010
2 Biomass Geothermal Waste Hydro Solar Wind PV Please click to enter the site By entering this web site, you are deemed to have read and accepted the disclaimer and copyright information Last updated 07 June 1999
3 The Energy Efficiency and Renewable Energy Network (EREN) is the U.S. Department of Energy's comprehensive resource for energy efficiency and renewable energy information
4 Environmental Energy Technologies Division Web Page
5 CADDET Renewable Energy Provides Information and Project Examples on the Following Technologies Biomass Geothermal Waste Hydro Solar Wind PV
6 US Dept of Energy's Energy Efficiency and Renewable Energy Network resource focusing on fuels, geothermal, hydropower, solar and wind energy
7 The Renewable Resource Data Center Web (RReDC) site provides publications, data, and maps on biomass, geothermal, solar radiation, and wind resources in the United States
Add a site
Internet

Figure X.14: Links summary – search criterion: Energy, Government Information Dissemination

D. News module

114. The news module of the prototype includes a web message board (technology forum) to facilitate the exchange of views and experiences on the development and transfer of technologies. This feature may prove beneficial in stimulating active participation of the Parties in the technology transfer process under the Convention. To use the message board, proceed as follows:

(a) Click on the "Forum" folder in the left-hand side table of contents. The list will expand with sub-folders on "Forum and Chat" (different versions);

(b) Click on the "Forum" sub-folder. The Technology Transfer Forum page will be displayed (figure X.15);

(c) Select one subject from the list or type in a new subject in the "Subject" field;

(d) Introduce the author name, e-mail and web page;

(e) Type in your message and click the "Submit" button.

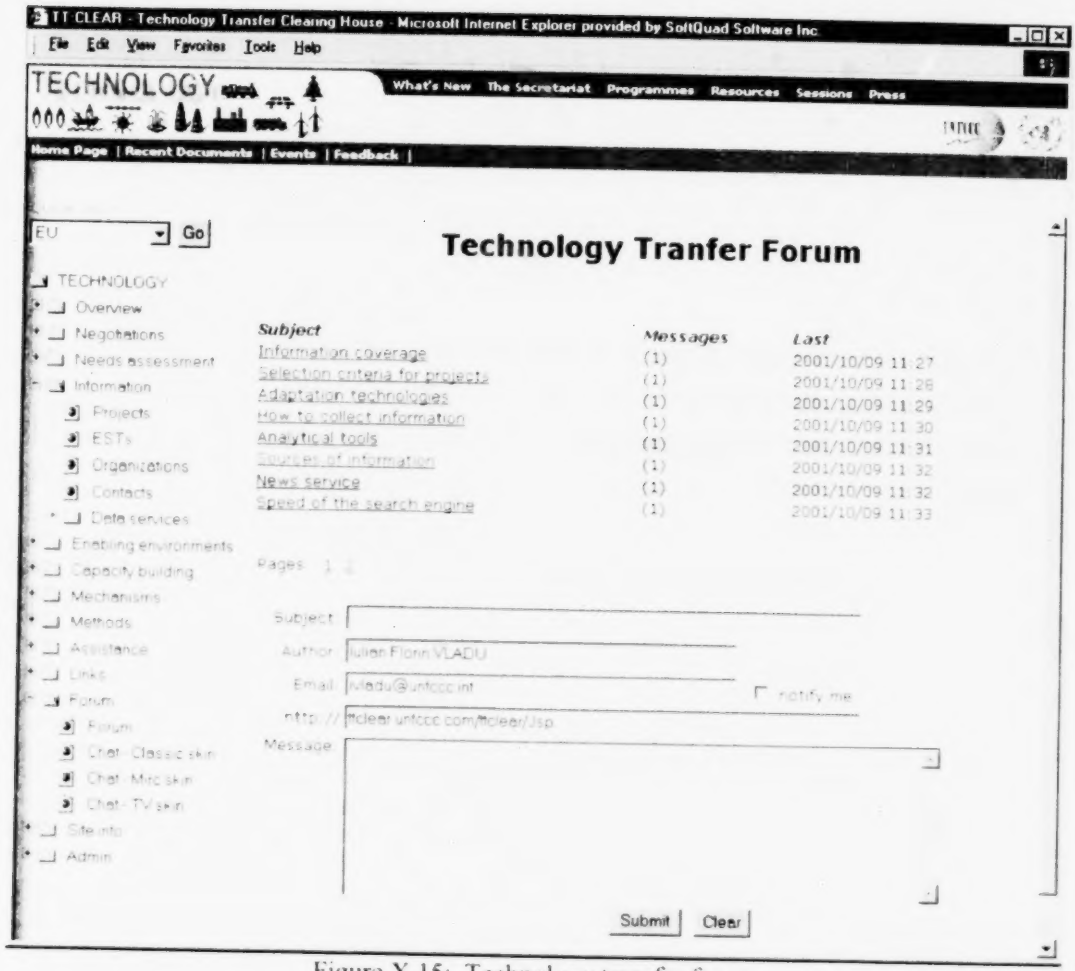

Figure X.15: Technology transfer forum

115. The web message board can become a very efficient way of exchanging information. The main advantage of such systems is that the knowledge exchanged can be stored and made available to other users through search engines.

116. The effectiveness of the message board depends significantly on the amount and quality of information exchanged. Therefore, it will be essential to attract not only users, who are asking questions, but also good experts, who can provide answers to those questions. To start the process, a critical mass of information, in the form of questions and answers, must be collected and made available through the message board.

117. The message board can also be connected to other elements of the system such as the technology transfer projects. This will allow users to exchange views on a given project.

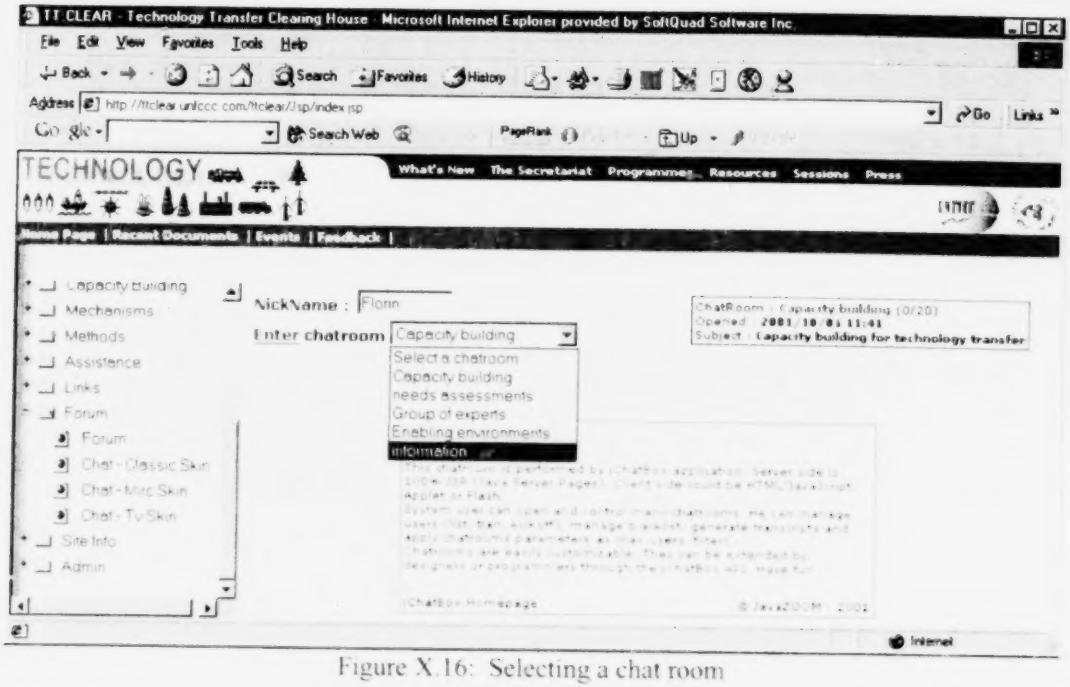

Figure X.16: Selecting a chat room

118. The prototype also includes several chat rooms to share ideas and information in a more structured manner than is currently possible using e-mail alone. Chat rooms were created for technology needs assessment, technology information, enabling environments, capacity-building and the group of experts on technology transfer. Figures X.16 and X.17 illustrate how to select, enter and use a chat room.

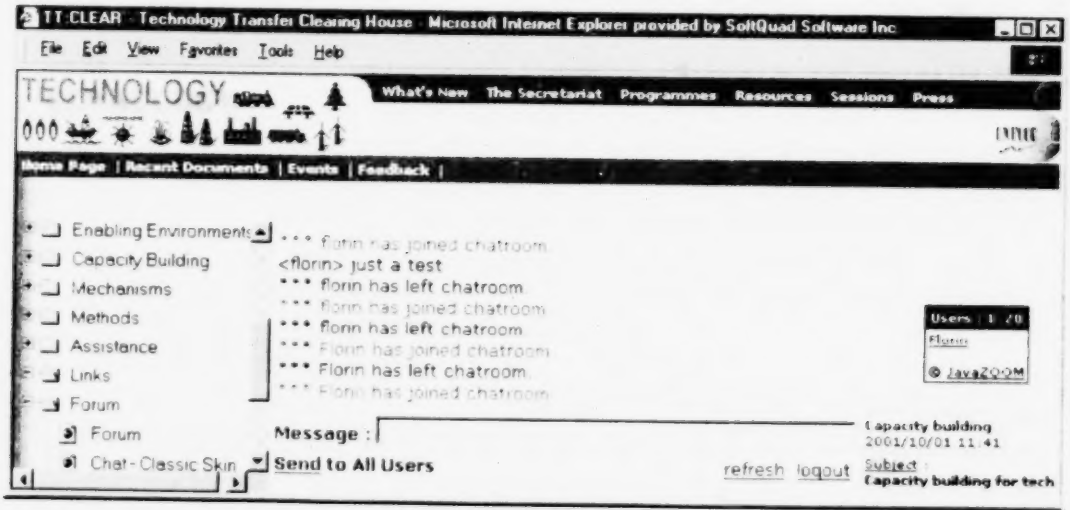

Figure X.17: Chat room

E. Technology side-by-side comparison

119. Sometimes it is useful to perform simple side-by-side comparisons of different technologies. To access this feature of the prototype, click on the "Methods" folder in the table of contents. The list will expand with sub-folders on Assessment and Comparison. Then click on the "Comparison" sub-folder and then on "Energy Supply" (the only one implemented). The Comparison of Energy Supply Technologies page will be displayed (figure X. 18).

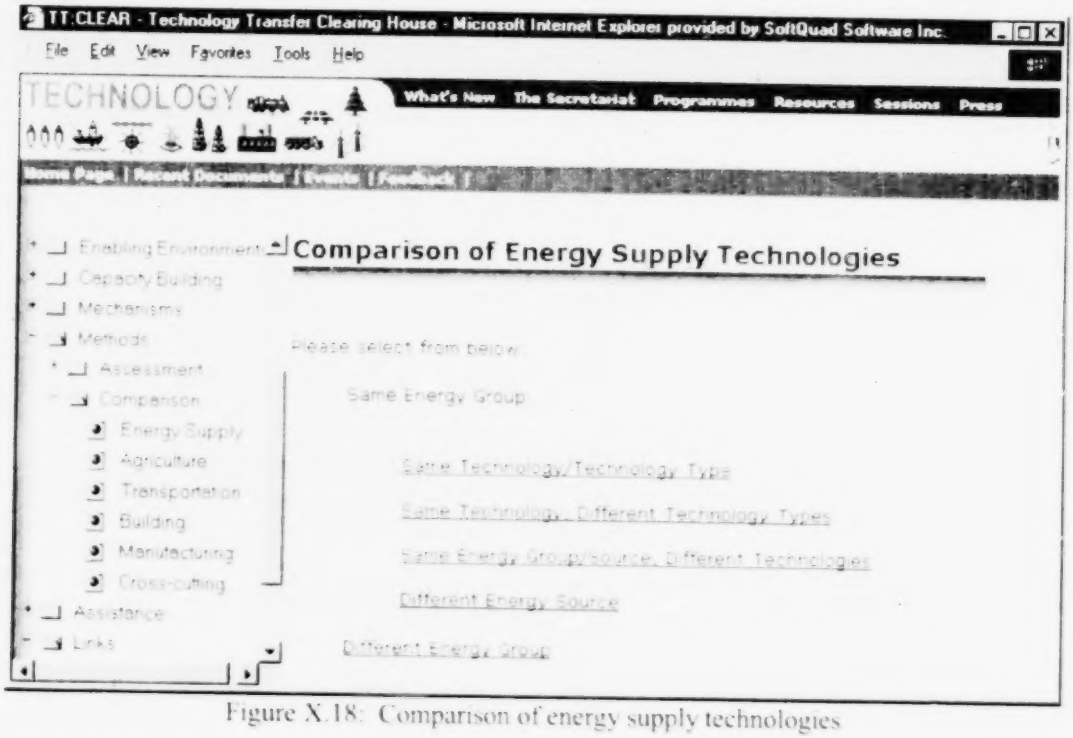

Figure X.18: Comparison of energy supply technologies

120. Several types of comparisons are possible:

(a) Same technology/technology type (e.g., biomass combustion plants);

(b) Same technology, different technology types (e.g., pressurized fluidised bed combustion with atmospheric fluidised bed combustion);

(c) Same energy group/source, different technologies (oil boilers with oil turbines or diesel generators);

(d) Different energy sources (e.g., gas boilers with biomass combustion systems);

(e) Different energy group (e.g., pulverized coal with nuclear reactors and biomass combustion systems).

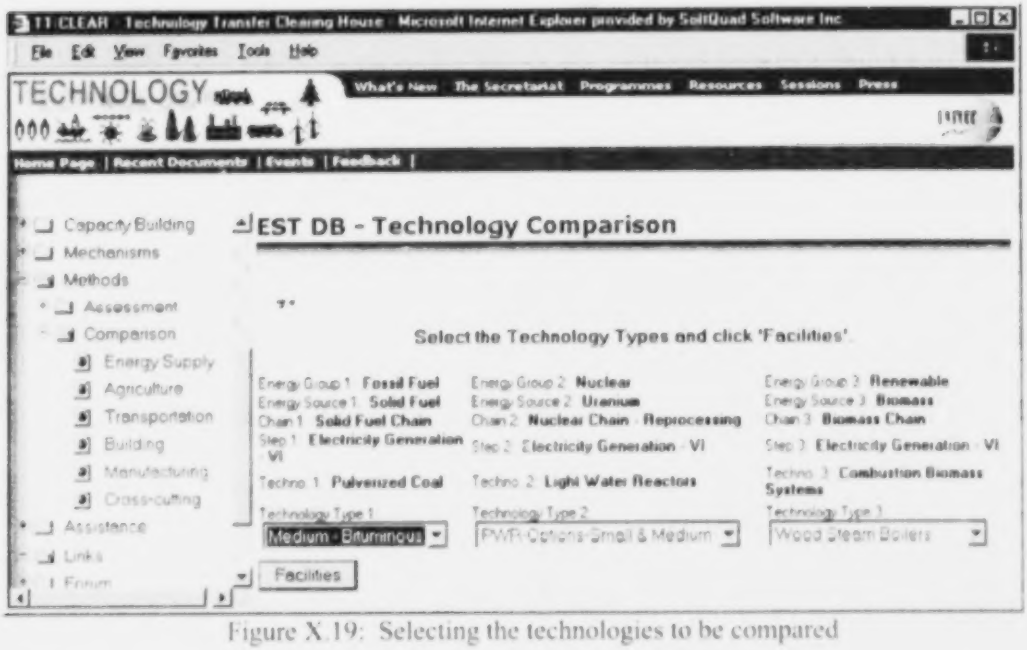

Figure X.19: Selecting the technologies to be compared

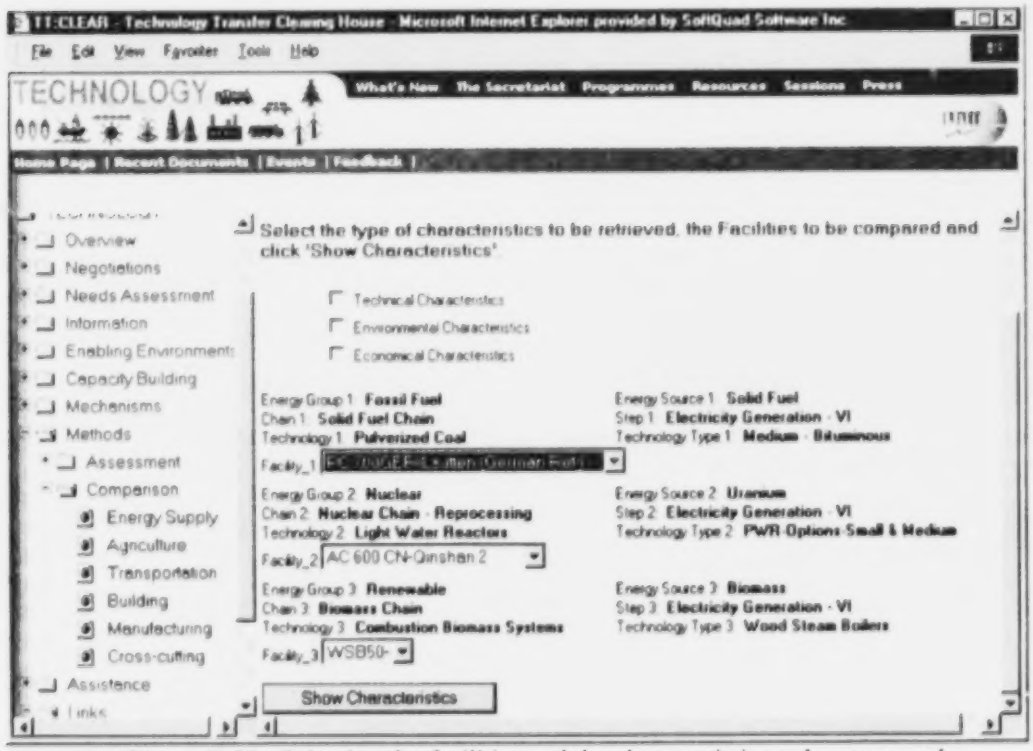

Figure X.20: Selecting the facilities and the characteristics to be compared

121. To make a comparison, select the comparison type (e.g., "Different Energy Group"), continue by selecting from the drop-down lists the energy group(s), source(s), the step in the fuel chain, and the technology(ies) and sub-technology(ies) desired (figure X. 19). Then select the characteristics to be compared by checking the corresponding boxes of technical, economic and environmental characteristics (figure X. 20), and click the "Show Characteristics" button to display the side-by-side comparison table (figure X. 21).

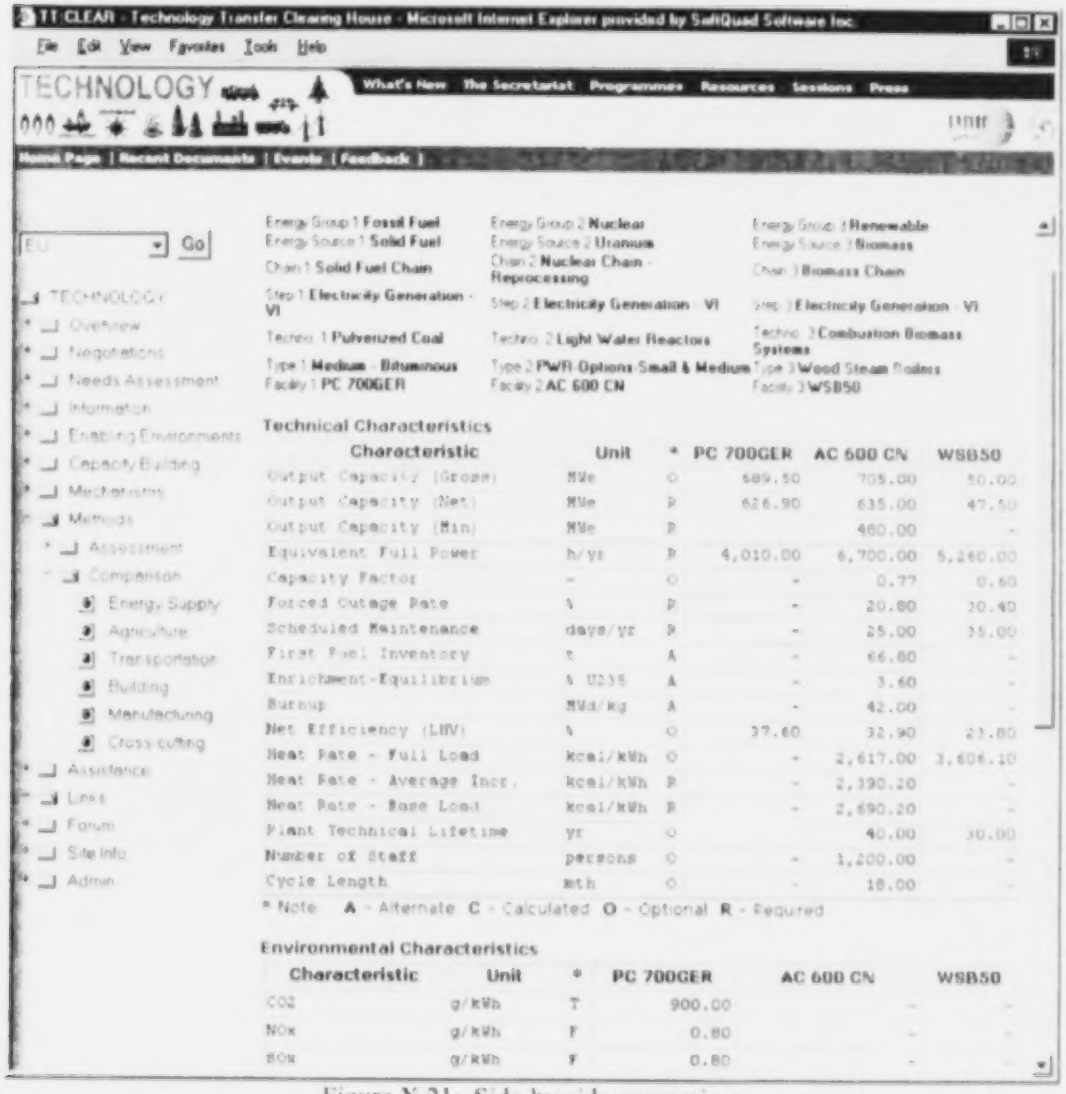
TT:CLEAR - Technology Transfer Clearing House - Microsoft Internet Explorer provided by SoftQuad Software Inc.
File Edit View Favorites Tools Help
TECHNOLOGY
What's New The Secretariat Programmes Resources Sessions Press
Home Page | Recent Documents | Events | Feedback |
EU Go
TECHNOLOGY
Overview
Negotiations
Needs Assessment
Information
Enabling Environments
Capacity Building
Mechanisms
Methods
Assessment
Comparison
Energy Supply
Agriculture
Transportation
Building
Manufacturing
Cross-cutting
Assistance
Links
Forum
Site Info
Admin
Energy Group 1 Fossil Fuel
Energy Source 1 Solid Fuel
Chain 1 Solid Fuel Chain
Step 1 Electricity Generation - VI
Techno 1 Pulverized Coal
Type 1 Medium - Bituminous
Facility 1 PC 700GER
Energy Group 2 Nuclear
Energy Source 2 Uranium
Chain 2 Nuclear Chain - Reprocessing
Step 2 Electricity Generation - VI
Techno 2 Light Water Reactors
Type 2 PWR-Options Small & Medium
Facility 2 AC 600 CN
Energy Group 3 Renewable
Energy Source 3 Biomass
Chain 3 Biomass Chain
Step 3 Electricity Generation - VI
Techno 3 Combustion Biomass Systems
Type 3 Wood Steam Boilers
Facility 3 WSB50
Technical Characteristics
Characteristic Unit * PC 700GER AC 600 CN WSB50
Output Capacity (Gross) MWe O 689.50 705.00 50.00
Output Capacity (Net) MWe R 626.90 635.00 47.50
Output Capacity (Min) MWe R 460.00 -
Equivalent Full Power h/yr R 4,010.00 6,700.00 5,260.00
Capacity Factor - O - 0.77 0.60
Forced Outage Rate % R - 20.80 20.40
Scheduled Maintenance days/yr R - 35.00 35.00
First Fuel Inventory t A - 66.60 -
Enrichment-Equilibrium % U235 A - 3.60 -
Burnup MWd/kg A - 42.00 -
Net Efficiency (LHV) % O 37.60 32.90 23.80
Heat Rate - Full Load kcal/kWh O - 2,617.00 3,606.10
Heat Rate - Average Incr. kcal/kWh R - 2,390.20 -
Heat Rate - Base Load kcal/kWh R - 2,690.20 -
Plant Technical Lifetime yr O 40.00 30.00
Number of Staff persons O - 1,200.00 -
Cycle Length mth O - 18.00 -
* Note: A - Alternate C - Calculated O - Optional R - Required
Environmental Characteristics
Characteristic Unit * PC 700GER AC 600 CN WSB50
CO2 g/kWh T 900.00 - -
NOx g/kWh F 0.80 - -
SOx g/kWh F 0.80 - -

Figure X.21: Side-by-side comparison

122. The ESTs database stores generic/representative values for different energy technologies following the fuel chain approach, from mining to waste disposal. Therefore, similar comparisons can be made for other technologies such as mining, fuel transportation, fuel processing and waste disposal.

F. System management module

123. This module is accessible only by system administrators. It allows them to perform different tasks such as monitoring the use of the system (web log), managing the technology forum message board, opening, closing and creating chat rooms, or starting and stopping web services

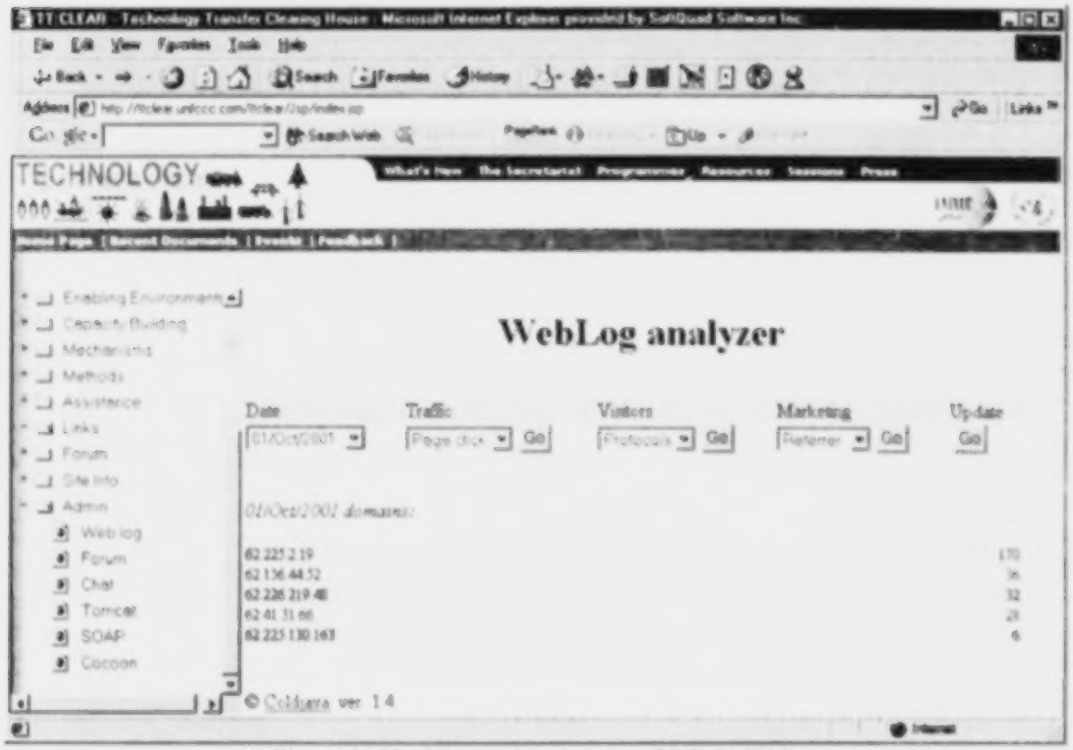

Figure X.22: Monitoring the use of TT:CLEAR

124. The webLog analyzer (figure X. 21) allows system administrators to monitor key elements of system use such as number of hits, number of visitors, Internet pages accessed, internet address of the users, HTTP protocols used, types of browser. This information may be useful in estimating the use of the system and in developing the prototype further.

XI. REFERENCES

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2. Report of the Conference of the Parties on its second session, held in Geneva from 8 to 19 July 1996, Part two: action taken by the Conference of the Parties at its second session, Addendum, FCCC/CP/1996/15/Add.1.

3. Report of the Conference of the Parties on its third session, held in Kyoto from 1 to 11 December 1997, Addendum, FCCC/CP/1997/Add.1.

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9. Report Prepared for Working Group II of the IPCC as an Annex to the Second Assessment Report, "Inventory of Technologies, Methods, and Practices for Reducing Emissions of Greenhouse Gases", Argonne National Laboratory, United States of America, 1994.

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12. DECADES Project Document No. 3, DECADES Tools User's Manual for Version 1.0, IAEA, Vienna, 2000.

XII. ANNEXES

Annex A

Project technology inventory database

1. The project technology inventory (PTI) database was developed and implemented in MS Access, and contains seven data tables covering the following information (table A.1):

Table A.1. Tables used in PTI database

1. Projects • project_id • project_title • project_description • donor_id • source_id • contact • donor funding • host or other contributors	2. Country_Multilaterals[26] • id_area • id_kind_area • cod_ARA_3AL • cod_ARA_12AL • name_ARA • name_ARA_ing • txt_dsc_ARA • nationality • dial_prefix • short_name	3. Implementing Agency • impl_ag_id • impl_ag_name • impl_ag_name_lg
4. Information Source • source_id • source_name	5. Project_donor_link • project_id • cod_ARA_3AL	6. Projet_host_country_link • project_id • cod_ARA_3AL
7. Project_implementing_agency_link • project_id • impl_ag_id		

2. The relations between these tables are shown in figure A.1. The conceptual model of the PTI database is relative simple. All relations are of "one-to-one" type. Some tables include fields that are not needed (e.g., dnor_ID in Projects table).

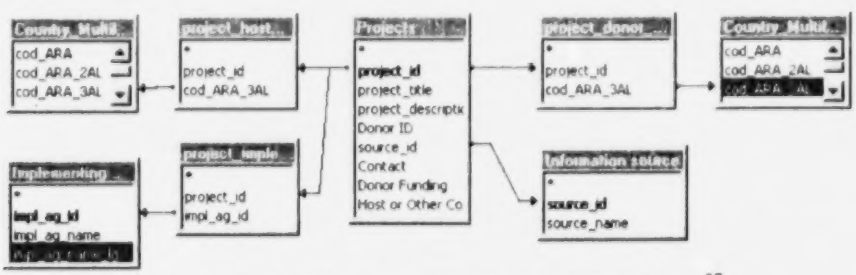


Figure A.1. Relation between tables in PTI database[27]

3. The conceptual model of the database has errors (e.g., countries are mixed with regions in the same tables), many important data elements are missing (e.g., estimated GHG emissions) and the data structure is not normalized (in the database design sense). The database should be

---

[26] This table was imported for the CIS database of the UNFCCC.

[27] A single arrow end denotes a "one-to-one" relation. A double arrow end denotes a "one-to-many" relation.

redesigned, therefore, to remove these errors and to extend its coverage. Table A.2 presents a comparison between the data coverage of PTI and other similar databases.

Table A.2. Comparison between the coverage of three project databases

UNFCCC PTI Database	CADDET	International Greenhouse Partnership Australia
Projects • Project title • Project description • Donor • Host • Implementing agencies • Funding	Project description • General description • Technical data • Energy data • Economic data • Environmental data	Project description
-	-	Project Benefits
-	Keywords	-
-	Project details • Project number (e.g., US-99-521) • Project type (results, ..) • Start date • End date • Country • CADDET brochure • Primary sector • Primary technology • Secondary sector • Secondary technology	-
Donor country organization (?) • Donor name • Region	-	Australian [donor] company • Donor name
-	Organization(s) • Organization [name] • Abbreviation • Role • Address • Tel • Fax • E-mail • Related projects	-
Contact • Contact details Host country region (?) • Host name • Region	Contact(s) • Contact [name] • Title • Department • Tel • Fax -	Company contact • Contact [name] • Title • Company • Department • Tel • Fax Host country • Host name • Host country organization

UNFCCC PTI Database	CADDET	International Greenhouse Partnership Australia
Implementing agencies • Implementing agency name • Contact details		
-	-	Project cost
-	-	Estimated CO_2 emission reduction

4. Simple forms for data introduction and maintenance have also been prepared. For illustrative purposes, the main data form used to enter the project data is shown in figure A.2. The form contains drop-down menues for selection of the donor and host countries, information sources and the implementing agency.

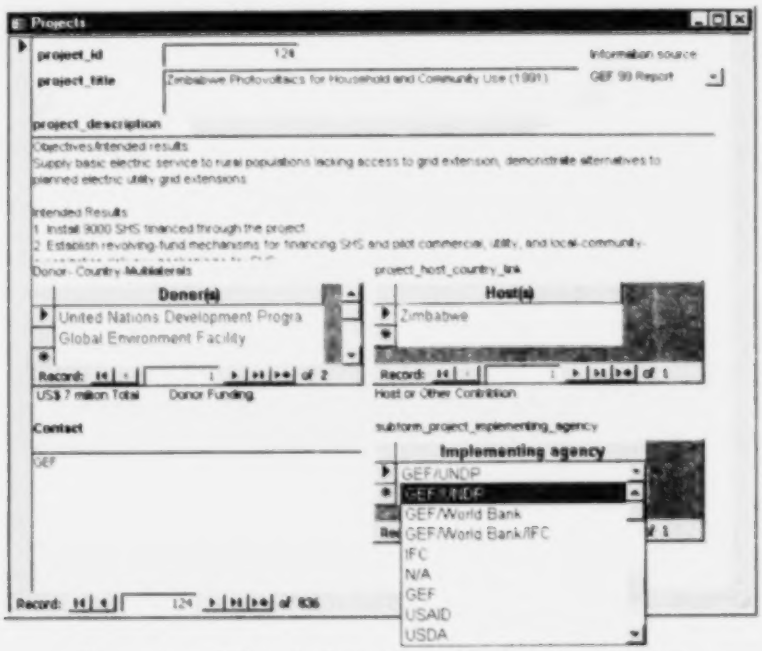


Figure A.2. PTI main form for project data introduction

5. The database can be queried, in a very simple manner, on different criteria such as donor country, host country, implementing agency, project title or description. The results of such a query are presented in the form of a report (figure A.3).

6. The PTI database was presented to the Parties at the twelfth session of the SBSTA.

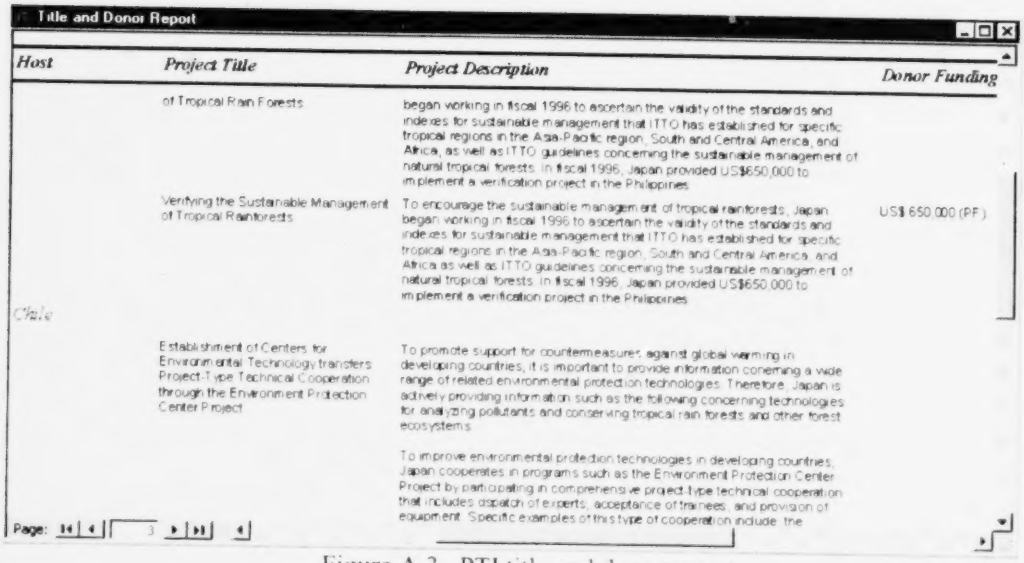

Title and Donor Report
Host
Project Title
Project Description
Donor Funding
of Tropical Rain Forests
began working in fiscal 1996 to ascertain the validity of the standards and indexes for sustainable management that ITTO has established for specific tropical regions in the Asia-Pacific region, South and Central America, and Africa, as well as ITTO guidelines concerning the sustainable management of natural tropical forests. In fiscal 1996, Japan provided US$650,000 to implement a verification project in the Philippines.
Verifying the Sustainable Management of Tropical Rainforests
To encourage the sustainable management of tropical rainforests, Japan began working in fiscal 1996 to ascertain the validity of the standards and indexes for sustainable management that ITTO has established for specific tropical regions in the Asia-Pacific region, South and Central America, and Africa as well as ITTO guidelines concerning the sustainable management of natural tropical forests. In fiscal 1996, Japan provided US$650,000 to implement a verification project in the Philippines.
US$ 650,000 (PF)
Chile
Establishment of Centers for Environmental Technology transfers Project-Type Technical Cooperation through the Environment Protection Center Project
To promote support for countermeasures against global warming in developing countries, it is important to provide information concerning a wide range of related environmental protection technologies. Therefore, Japan is actively providing information such as the following concerning technologies for analyzing pollutants and conserving tropical rain forests and other forest ecosystems.
To improve environmental protection technologies in developing countries, Japan cooperates in programs such as the Environment Protection Center Project by participating in comprehensive project-type technical cooperation that includes dispatch of experts, acceptance of trainees, and provision of equipment. Specific examples of this type of cooperation include the
Page:
3

Figure A.3. PTI title and donor report

Annex B

UNFCCC climate technology pilot web site

1. The pilot project web site has been developed by ICF Consulting, with support from the United States Government, and is hosted on its servers. ICF experts have been actively involved in the technology transfer consultative process and have participated in the regional workshops organized during this process.

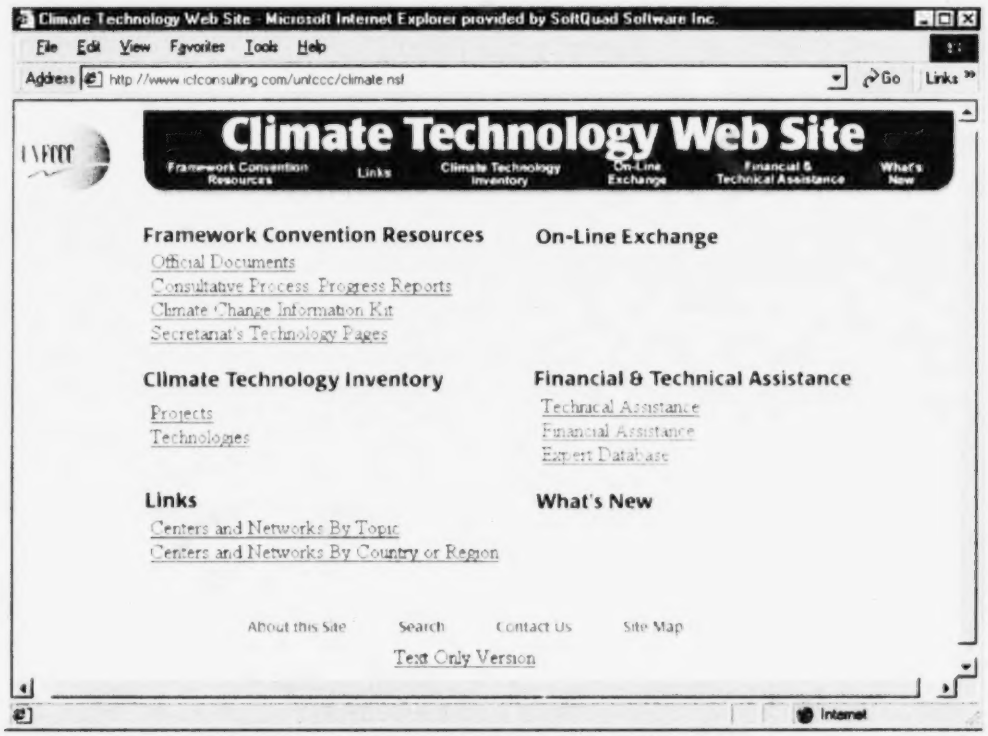


Figure B.1. Climate technology pilot project web site

2. The main characteristics of the pilot web site (figure B.1) are summarized as follows:

(a) The site reflects many of the recommendations made during the regional workshops on the technology transfer consultative process;

(b) It uses CTI's search engine to query the CTI databases on bibliographic information related to climate friendly technologies and technology cooperation projects;

(c) The site can be displayed in a "text only" mode for users with old internet technology;

(d) It is linked to main data providers such as IEA Greentie Directory Database, CADDET Renewable Energy Programme, CADDET Energy Efficiency Products (includes an

Energy Efficiency Register database), National Renewable Energy Laboratory (NREL) Renewable Energy Information and others;

(e) The site is relatively integrated with the UNFCCC web site;

(f) It has a mechanism for registering national and regional technology transfer centres over the Internet.

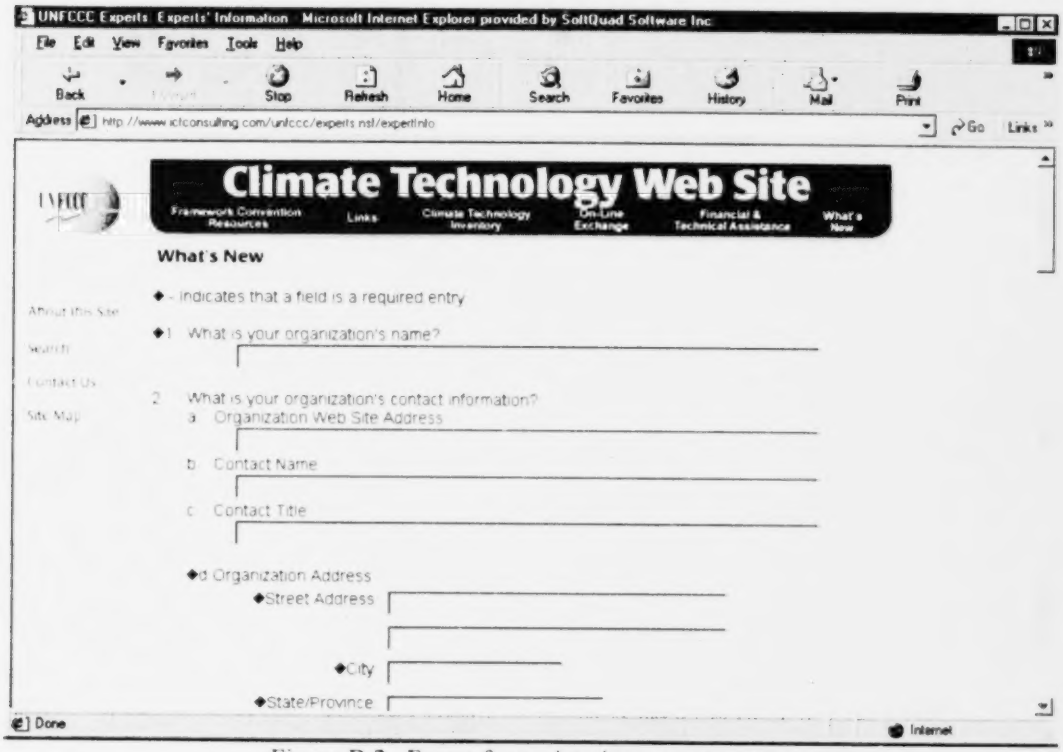


Figure B.2. Forms for registering expert centres

3. The site allows for registration of national and regional expert centres through the Internet (figure B.2). This feature will be used to create and maintain the database on technology transfer centres.

4. The site was implemented and runs under, Lotus Notes (Domino). This system is different from the UNFCCC standard for databases and Internet web sites. Therefore, a transfer of the site to the secretariat may create some technical problems.

Annex C

Technology information clearing house functional prototype (alpha version)

5. The secretariat has developed a functional prototype of TT:CLEAR. The prototype has a flexible and user-friendly interface with the following main characteristics (see figure C.1):

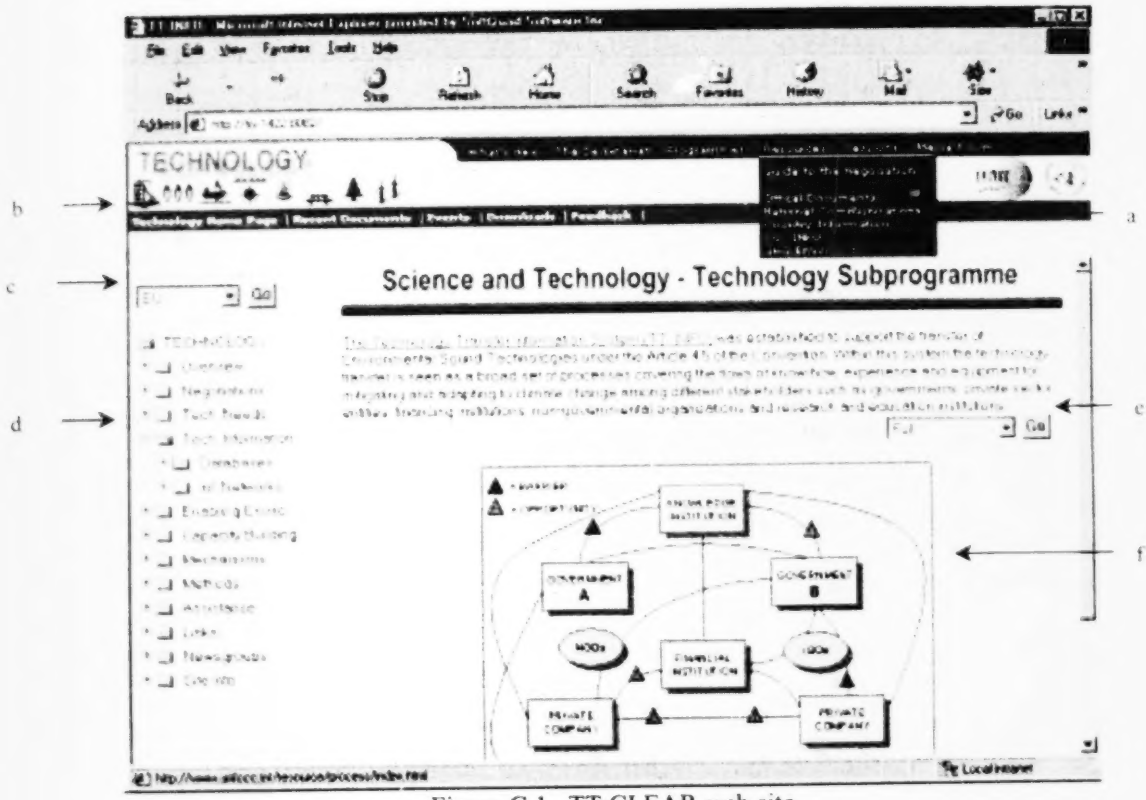


Figure C.1. TT:CLEAR web site

(a) The prototype site may easily be integrated with the UNFCCC main web site. The global menu ("a" in figure C.1) provides the same options as the main UNFCCC site. Furthermore, it has drop-down menus to access specific pages of that site;

(b) A second pop-up menu is provided to connect the clearing house with the science and technology pages and to provide some quick links to recent documents, events, etc.

(c) A drop-down list was included for quick links to main technology web sites;

(d) A folder tree navigation menu is used to access the main pages of the site;

(e) A drop-down list was added to allow the use to select the different menu type for the folder (e.g., full menu, negotiation menu, assistance menu) which reduces the number of options and simplifies navigation of the site;

(f) The interface was constructed using frames. This technique reduces the download time and permits the user to print only the content of the main frame.

6. The site provides dynamic access to TT:DATABASES powered by a specially designed web application. The components of this application, as well as the data flows, are shown in figure C.2.

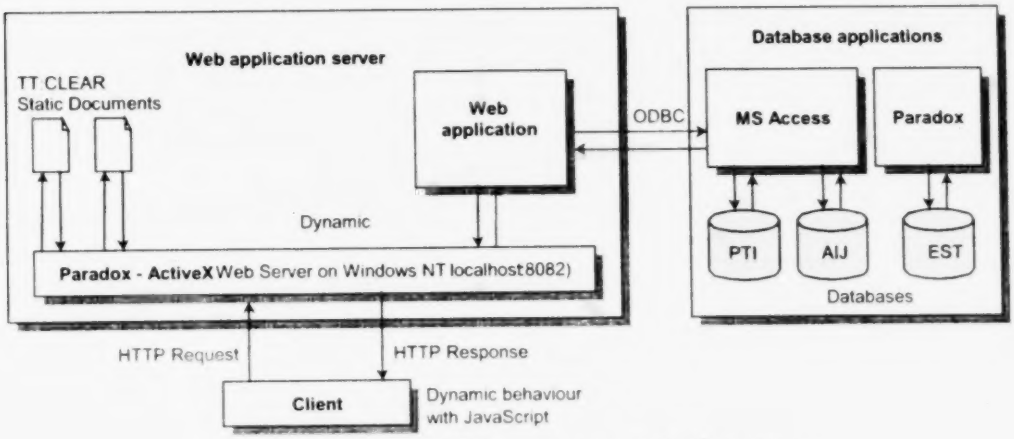


Figure C.2. TT:CLEAR prototype main elements

7. The prototype allows the user to query the TTProjects by imposing filters on donor country, recipient country, implementing agency and to provide a text in the project title or project description (figure C.3).

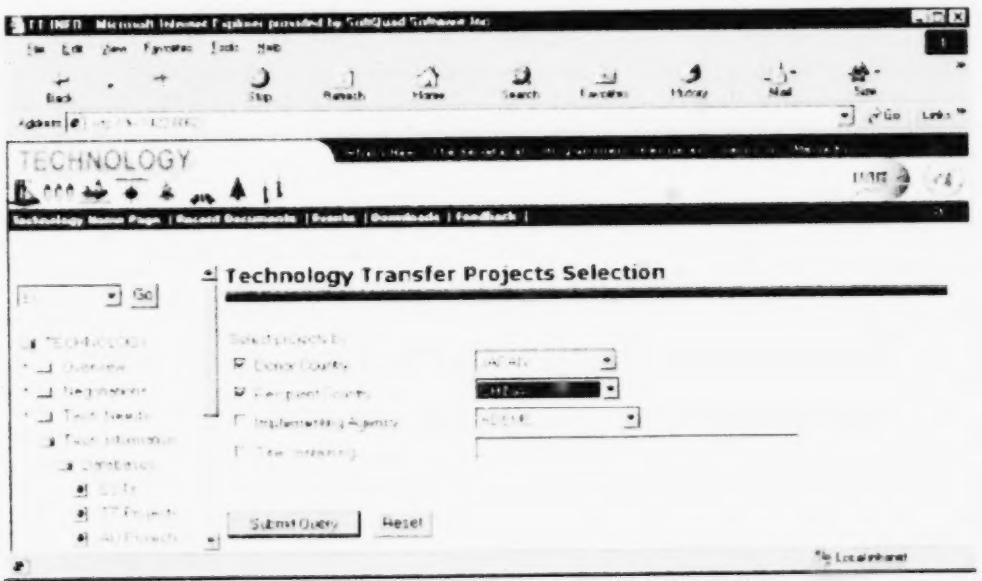


Figure C.3. Selecting projects from TTProjects DB

8. The results of a query to the TTProjects database are shown in figure C4. It can then be accessed and updated as necessary. The detailed information given for each project in the query result.

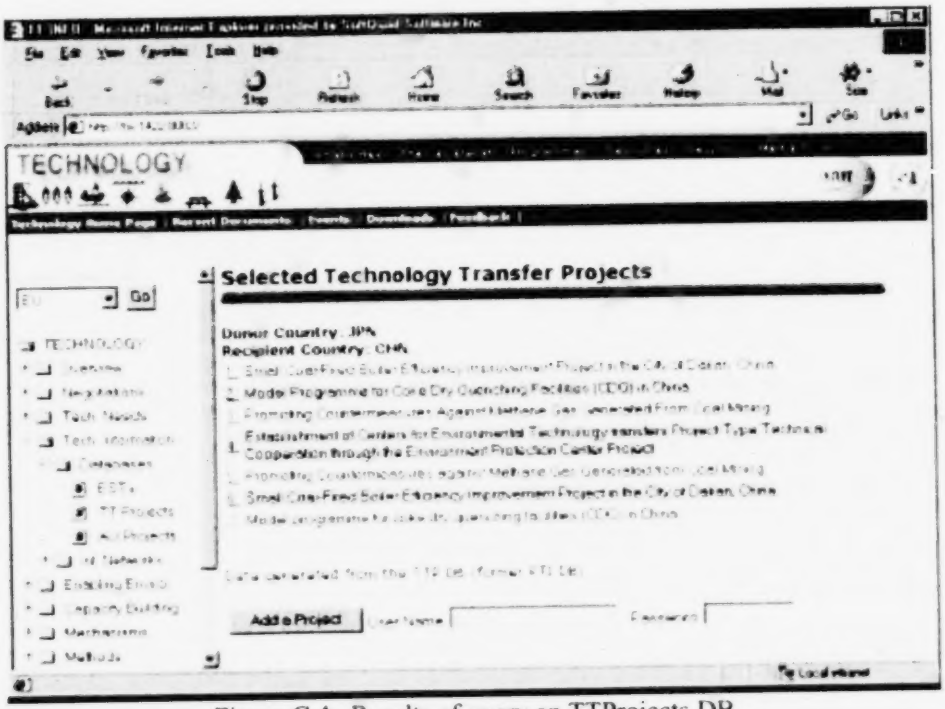


Figure C.4. Results of query on TTProjects DB

9. New projects can be added, deleted or modified directly by Parties, using a password.

10. Dynamic web pages are prepared to display the information from the EST DB. The information is organized by technology chains. Side-by-side comparison of different technologies, in terms of their technical performance, economic parameters and environmental characteristics, is also possible (figure C.5).

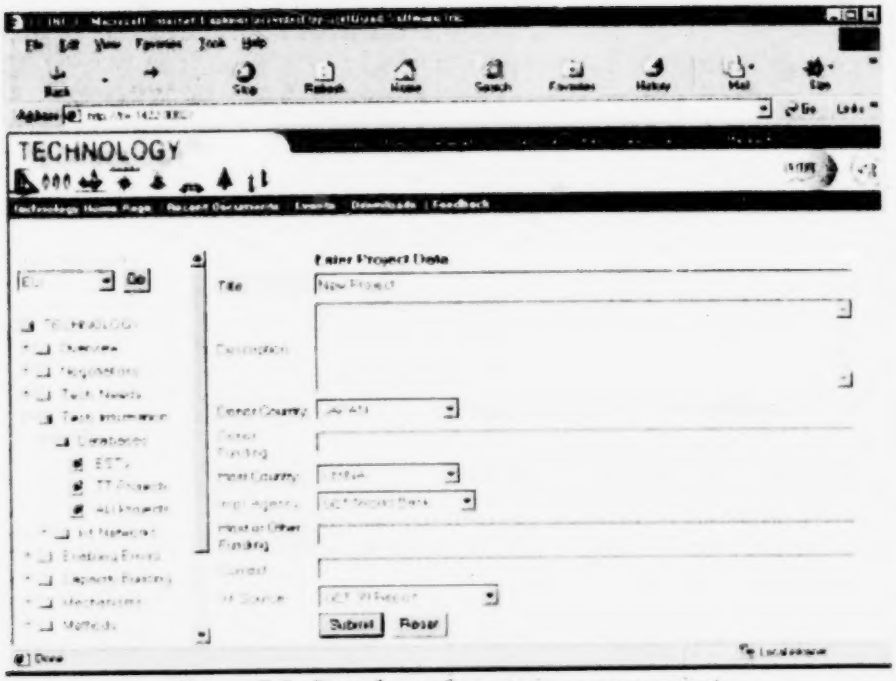


Figure C.5. Data forms for entering a new project

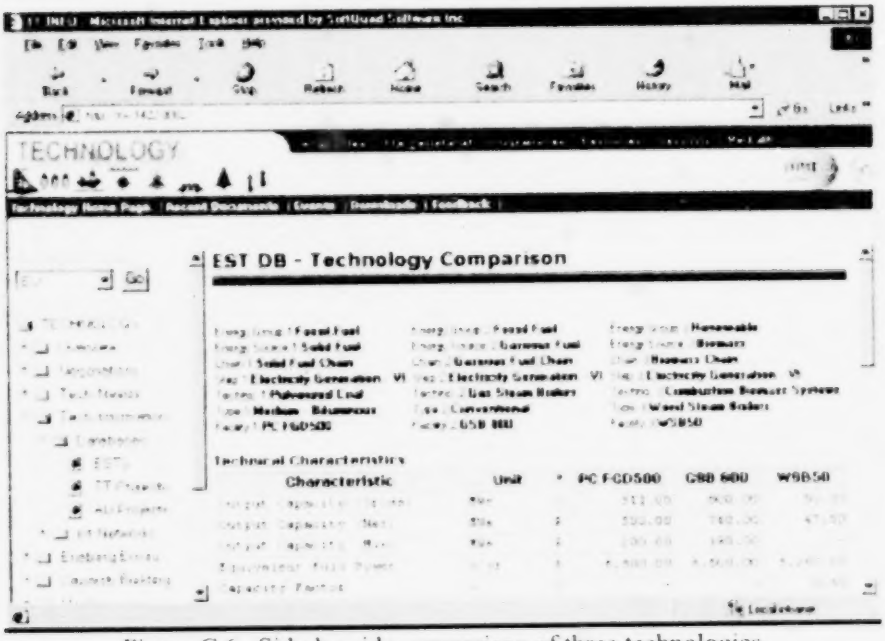


Figure C.6. Side-by-side comparison of three technologies

11. The prototype has been used to test and benchmark different software solutions, including methods for connecting to the database. Table A.1 provides a comparison of the speed of access

to the information in the databases for several web servers; it also lists drivers for connecting to the database and connection methods. The results show a substantial increase the access speed with the use of connection pooling.

12. Although not indicated by these results, it is expected that the access speed will also increase when using the Apache/Tomcat web server, as the increase of the numbers of hits on the database increases.

Table C.1. Comparison of access speed for different combinations of web servers and database management systems

web server	Driver	Database	Conn. pooling	Rand key	# of hits	# of threads	Time	Remarks
Paradox	ODBC	Access	No	1-99	100	10	26355	Paradox pageWorks on multiple threads
Tomcat	JDBC-ODBC	MS SQL	No	1-99	100	1	12375	JSPCrushes on multiple threads
Tomcat	JDBC-ODBC	Access	No	1-99	100	1	?	JSP Crushes on multiple threads
Tomcat	JDBC 4	MySQL	No	1-8	100		38,235 34,578	Modified JSP
Tomcat	JDBC 4	MySQL	10 5	1-8	1000	10	28,125 30,172	Modified JSP~ 26% reduction
Tomcat	JDBC 4	MySQL	10 10	1-8	1000	10	31,406 29,640	Modified JSP~ 22% reduction

Annex D

Climate change marker

Aid targeting the objectives of the United Nations framework convention on climate change[*]	
DEFINITION	
An activity should be classified as climate change-related (score Principal or Significant) if:	It contributes to the objective of stabilization of GHG concentrations in the atmosphere at a level which would prevent dangerous anthropogenic interference with the climate system by promoting efforts to reduce or limit GHG emissions or to enhance GHG sequestration
CRITERIA FOR ELIGIBILITY	The activity contributes to a) the mitigation of climate change by limiting anthropogenic emissions of GHGs, including gases regulated by the Montreal Protocol; **or** b) the protection and or enhancement of GHG sinks and reservoirs; **or** c) the integration of climate change concerns with the recipient countries' development objectives through institution building, capacity development, strengthening the regulatory and policy framework, or research; **or** d) developing countries' efforts to meet their obligations under the Convention The activity will score "**principal objective**" if it directly and explicitly aims to achieve one or more of the above four criteria
EXAMPLES OF TYPICAL ACTIVITIES **1. Typical activities take place in the sectors of:** *Water and sanitation* *Transport* *Energy* *Agriculture* *Forestry* *Industry*	• GHG emission reductions or stabilization in the energy, transport, industry and agricultural sectors through application of new and renewable forms of energy, measures to improve the energy efficiency of existing generators, machines and equipment, or demand side management. • Methane emission reductions through waste management or sewage treatment. • Development, transfer and promotion of technologies and know-how as well as the building of capacities that control, reduce or prevent anthropogenic emissions of GHGs, in particular in waste management, transport, energy, agriculture and industry. • Protection and enhancement of sinks and reservoirs of GHGs through sustainable forest management, afforestation and reforestation, and or rehabilitation of areas affected by drought and desertification
2. Typical non-sector specific activities are: *Environmental policy and administrative management* *Biosphere protection* *Biodiversity* *Env. education/training* *Environmental research*	• Protection and enhancement of sinks and reservoirs through sustainable management and conservation of oceans and other marine and coastal ecosystems, wetlands, wilderness areas and other ecosystems. • Preparation of national inventories of greenhouse gases (emissions by sources and removals by sinks), climate change-related policy and economic analysis and instruments, including national plans to mitigate climate change, development of climate change-related legislation, climate technology needs surveys and assessments, institutional capacity-building. • Education, training and public awareness relating to climate change. • Climate change-related research and monitoring as well as impact and vulnerability assessments. • Oceanographic and atmospheric research and monitoring.

[*] OECD draft proposal within the pilot study "Aid targeting the Rio Conventions"

Annex E

Technology classification system

1. Within the UNFCCC technology transfer process, ESTs are classified by several criteria such as adaptation/mitigation, hard/soft, publicly/privately owned. However, a complete classification system has not yet been developed. For the purpose of the present project, ESTs can be classified using two internationally recognized systems: (i) according to technical expertise and (ii) according to economic activities. The classification system should then be extended to cover adaptation technologies and the other categories used in UNFCCC documents (e.g., hard/soft, public/private).

2. The IPCC working group II, second assessment report (IPCC SAR), used the technical expertise classification. The following tables give some details of this classification system.

Table E.1. Classification according to technical expertise (IPCC SAR)

Energy supply technologies
- Fossil fuel
- Renewable energy
- Nuclear

Energy transportation and distribution

Energy end-use technologies
- Transportation sector
- Building technologies
- Manufacturing technologies (industrial)

Agricultural and forestry practices
- Agriculture and forestry

Other techniques

3. The classification can be further extended to reflect the technologies available for transfer in each group of technical expertise. For illustrative purposes, a classification of energy supply technologies is shown in table E.2.

Table E.2. Proposed classification for energy supply technologies

Fossil fuels	Nuclear	Renewable energies
Coal steam boiler (CSB)	Light water reactors (LWR)	Hydropower (HYD)
Pulverised coal (PC)	Conventional pressurized water	Run of river (HYDR)
Cyclone furnace (CF)	reactors (PWR)	Storage (HYDS)
Spreader stoker (SS)	Advanced (APWR) pressurized	Pumped storage (HYDP)
(CO_2 recovery O_2 CO_2 burning)	water reactors (PWR)	(small, large)
Atmospheric fluidized bed combustion	Conventional boiling water reactors	Combustion biomass systems (incl.
(AFBC)	(BWR)	industrial and municipal waste)
Circulating (CFBC)	Advanced boiling water reactors	Wood steam boilers (WSB)
Bubbling (BFBC)	(ABWR)	Circulating FBC
Pressurized fluidized bed combustion	Pressurized heavy water reactor	Integrated gas. Combined-cycle
(PFBC)	(PWR)	Solar thermal (ST)
Combined-cycle	Gas cooled reactors (GCR)	Solar tower (ST)

Fossil fuels	Nuclear	Renewable energies
Circulating (CPFBC)	Conventional (GCR)	Parabolic trough (PT)
Bubbling (BPFBC)	High temperature (HTGC)	Parabolic dish/sterling (PD)
Coal gasification (CG)	Liquid metal reactors (LMR)	Solar photovoltaic (PV)
Non-integrated (GCC)	Fast breeder reactors (FBR)	Photovoltaic crystalline (PVCr)
Integrated (IGCC)		Photovoltaic amorphous (PVAm)
Integrated gasification HAT		Photovoltaic thin film (PVTf)
Coal-fired combustion turbine		Photovoltaic concentrators (PVCt)
(see gas turbines)		Wind (WIN)
Improved cycle (IC)		Horizontal axis (HAWT)
Gasification PFBC hybrid		Vertical axis (VAWT)
Binary rankine cycle		(onshore, offshore)
Magnetohydrodinamic		Geothermal (GEO)
Gas steam boiler (GSB)		Conventional
Conventional (GSB)		Binary
Gas-fired combustion turbine (GT)		Geopressurized
Simple cycle heavy duty (GTSCh)		Back pressure
Simple cycle aeroderivate (GTSCa)		Direct steam
Steam injected gas turbine (STIG)		Flashed steam
Humid air turbine (HAT)		Wave
Combined-cycle (GTCC)		Tidal
Fuel cell		OTEC
Phosphoric acid (PAFC)		
Molten carbonate (MCFC)		
Solid oxide (SOFC)		
Oil steam boiler (OSB)		
Conventional (OSB)		
Diesel engine (DE)		
Conventional (DE)		
Oil fired combustion turbine (CT)		
(see gas turbines)		

4 The classification by economic activities is defined by the International Standard Industrial Classification (ISIC) of all economic activities and is used in the national communications reporting system. The system, illustrated in table E.4, associates a numeric code to each economic activity.

Table E.3. Classification according to economic fields of expertise (ISIC – UNIDO)

Target groups by industry • Agriculture, hunting and forestry • Mining and quarrying • Manufacturing • Electricity, gas and water supply • Construction • Transport, storage and communication • Fishing • Wholesale and retail trade • Hotels and restaurants • Financial intermediation • Real estate, business activities • Public administration and defence • Education • Health and social work • Other community and social activities • Private households • Extra-territorial organizations	**Target groups by geographic area** • North America • Latin America & Caribbean • Western Europe • Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom • Eastern & Southern Europe • Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Slovak Republic, Slovenia, Portugal, Romania, Turkey • Africa • Former Soviet Republic • China • Japan • Other Asia • Australasia
Products or services • Project management • Consultancy • Engineering • Training/education • Reports/publications • Research/development • Resources • Components • Equipment machinery • Plants • Databank • Software • Financing	**Life cycle stage** • Basic research • Development • Prototyping • Demonstration • Application
Greenhouse gas • CO_2 • CFCs • CH_4 • N_2O • O_3 • CO • NO_x • H_2O	**Energy supply technologies: fossil fuels** • Atmospheric fluidized bed combustion • Coal beneficiation • Coal-water mixtures • Combined-cycle • Combustion turbines • Diesel cogeneration • Fuel cells • Industrial cogeneration • Gas/oil-fired steam units • Integrated gasification combined-cycle • Intercooled steam injected gas turbine • Pressurised fluidized bed combustion • Pulverised coal-fired power plant • Slagging combustors • Oil & natural gas technologies • Reduced venting & flaring of gas during

	production • Improved compressor operations • Improved leak detection • Low-emission technologies & practices • Coal mining technologies • Enhanced gob well recovery • Pre-mining degasification • Integrated recovery
Energy supply technologies: renewable energy • Biomass-fired power generation • Flat-plate photovoltaics • Geothermal electric • Municipal solid waste mass burn • Palletized biomass combustion • Biogas by anaerobic digestion • Small-scale hydro • Solar ponds • Solar thermal electric technologies • Parabolic trough • Central receiver • Parabolic dish/stirling engine • Wind energy conversion systems • Tidal energy • Ocean wave energy • Landfills' gas recovery & utilization techniques	**Energy supply technologies: nuclear** • Light water reactors • Heavy water reactors • Liquid metal fast reactors • Gas-cooled reactors
Energy supply technologies: energy transfer • Efficient electrical transformers • Electric transmission & distribution systems • Thermal energy storage systems • High voltage direct-current transmission	**Energy end-use transportation technologies** • Advanced signalizing • Battery electric vehicles • Compressed natural gas vehicles • Continuously variable transmission • Direct-injection diesel engines • Efficient jet aircraft • Efficient tyres • Ethanol vehicles • Fuel-cell electric vehicles • Two-stroke spark ignition engines • Urban transit systems
Energy end-use - building technologies • Energy management systems • Glazing technologies • Daylight control • Insulation • Solar control • Switchable • Heat pump water heaters • High-albedo materials • Landscaping • Lighting controls • Room air conditioners (window-type) • Solar domestic water heaters • Efficient cooking stoves	**Energy end-use – industrial technologies** • Anaerobic biological treatment of liquid waste • Biofiltration of gases • Cement particle high-efficiency air classifiers • Ceramic recuperators • Continuous pulp digesters • Continuous steel casters • Distillation control systems • Electric motors variable speed drives – industrial • Gas membrane separators • Heat exchange enhancement techniques • High efficiency welding power supply • Mechanical dewatering • Metal parts cleaning • Pinch technology

	• Pipe cross reactors • Plating waste concentrators • Pulse combustion boilers • Textile dyeing vacuum system
Agriculture & forestry practices • Reduction nitrogen fertilizer & animal manure • Reduction tillage & agriculture soils • Reforestation/afforestation & prevention of deforestation • Increasing efficiency/intensity of forest management • Substitution of fossil fuels with sustainably-grown fuelwood • Increasing agroforestry endeavours • Livestock technologies • Improved nutrition/mechanical & chemical feed processing • Improved nutrition/strategic supplementation • Production enhancing agents • Manure: covered lagoons • Manure: small-scale digesters • Manure: large-scale digesters	

Table E.4. Extracts from the ISIC of all economic activities, at the three and four-digit level.

300 Total manufacturing
: : 341 Paper and products
: : : 3411 Manufacture of pulp, paper and paperboard
: : : 3412 Manufacture of containers and boxes of paper and paperboard
: : : 3419 Manufacture of pulp, paper and paperboard articles not elsewhere classified
.....
: : 351 Industrial chemicals
: : : 3511 Manufacture of basic industrial chemicals except fertilizers
: : : 3512 Manufacture of fertilizers and pesticides
: : : 3513 Manufacture of synthetic resins, plastic materials and man-made fibres except glass
: : 352 Other chemicals
: : : 3521 Manufacture of paints, varnishes and lacquers
: : : 3522 Manufacture of drugs and medicines
: : : 3523 Manufacture of soap and cleaning preparations, perfumes, cosmetics and other toilet preparations
: : : 3529 Manufacture of chemical products not elsewhere classified
: : 353 Petroleum refineries
: : : 3530 Petroleum refineries
: : 354 Miscellaneous petroleum and coal products
: : : 3540 Manufacture of miscellaneous products of petroleum and coal
.....
: : 371 Iron and steel
: : : 3710 Iron and steel basic industries
: : 372 Non-ferrous metals
: : : 3720 Non-ferrous metal basic industries
: : : 3811 Manufacture of cutlery, hand tools and general hardware
: : 381 Fabricated metal products
: : : 3812 Manufacture of furniture and fixtures primarily of metal
: : : 3813 Manufacture of structural metal products
: : : 3819 Manufacture of fabricated metal products except machinery and equipment not elsewhere classified
: : 382 Machinery, except electrical
: : : 3821 Manufacture of engines and turbines
: : : 3822 Manufacture of agricultural machinery and equipment
: : : 3823 Manufacture of metal and woodworking machinery
: : : 3824 Manufacture of special industrial machinery and equipment except metal and woodworking machinery
: : : 3825 Manufacture of office, computing and accounting machinery
: : : 3829 Machinery and equipment except electrical not elsewhere classified
: : 383 Machinery, electric
: : : 3831 Manufacture of electrical industrial machinery and apparatus
: : : 3832 Manufacture of radio, television and communication equipment and apparatus
: : : 3833 Manufacture of electrical appliances and housewares
: : : 3839 Manufacture of electrical apparatus and supplies not elsewhere classified
: : 384 Transport equipment
: : : 3841 Shipbuilding and repairing
: : : 3842 Manufacture of railroad equipment
: : : 3843 Manufacture of motor vehicles
: : : 3844 Manufacture of motorcycles and bicycles
: : : 3845 Manufacture of aircraft
: : : 3849 Manufacture of transport equipment not elsewhere classified
: : 385 Professional and scientific equipment
: : : 3851 Manufacture of professional and scientific, and measuring and controlling, equipment not elsewhere classified
: : : 3852 Manufacture of photographic and optical goods
: : : 3853 Manufacture of watches and clocks
: : 390 Other manufactured products
: : : 3901 Manufacture of jewelry and related articles
: : : 3902 Manufacture of musical instruments
: : : 3903 Manufacture of sporting and athletic goods
: : : 3909 Manufacturing industries not elsewhere classified

5. The classification system used by OECD members to report on their development assistance activities is shown in table E.5

Table E.5. Extracts from the classification system used in the OECD Creditor Reporting System.

DAC 5 Code	CRS Code	Purpose Description
110		EDUCATION
111		Education, level unspecified
	11110	Education policy and administrative management
	11120	Education facilities and training
	11130	Teacher training
	11181	Educational research
112		Basic education
	11220	Primary education
	11230	Basic life skills for youth and adults
	11240	Early childhood education
113		Secondary education
	11320	Secondary education
	11330	Vocational training
114		Post-secondary education
	11420	Higher education
	11430	Advanced technical and managerial training
120		HEALTH
121		Health, general
	12110	Health policy and administrative management
	12181	Medical education/training
	12182	Medical research
	12191	Medical services
122		Basic health
	12220	Basic health care
	12230	Basic health infrastructure
	12240	Basic nutrition
	12250	Infectious disease control
	12281	Health education
	12282	Health personnel development
130		POPULATION POLICIES/PROGRAMMES AND REPRODUCTIVE HEALTH
	13010	Population policy and administrative management
	13020	Reproductive health care
	13030	Family planning
	13040	STD control including HIV/AIDS
	13081	Personnel development for population and reproductive health
210		TRANSPORT AND STORAGE
	21010	Transport policy and administrative management
	21020	Road transport
	21030	Rail transport
	21040	Water transport
	21050	Air transport
	21061	Storage
	21081	Education and training in transport and storage
220		COMMUNICATIONS
	22010	Communications policy and administrative management

DAC 5 Code	CRS Code	Purpose Description
	22020	Telecommunications
	22030	Radio/television/print media
230		ENERGY GENERATION AND SUPPLY
	23010	Energy policy and administrative management
	23020	Power generation/non-renewable sources
	23030	Power generation/renewable sources
	23040	Electrical transmission/ distribution
	23050	Gas distribution
	23061	Oil-fired power plants
	23062	Gas-fired power plants
	23063	Coal-fired power plants
	23064	Nuclear power plants
	23065	Hydro-electric power plants
	23066	Geothermal energy
	23067	Solar energy
	23068	Wind power
	23069	Ocean power
	23070	Biomass
	23081	Energy education/training
	23082	Energy research
311		AGRICULTURE
	31110	Agricultural policy and administrative management
	31120	Agricultural development
	31130	Agricultural land resources
	31140	Agricultural water resources
	31150	Agricultural inputs
	31161	Food crop production
	31162	Industrial crops/export crops
	31163	Livestock
	31164	Agrarian reform
	31165	Agricultural alternative development
	31181	Agricultural education/training
	31182	Agricultural extension
	31183	Agricultural research
	31184	Livestock research
	31191	Agricultural services
	31192	Plant and post-harvest protection and pest control
	31193	Agricultural financial services
	31194	Agricultural co-operatives
	31195	Livestock/veterinary services
312		FORESTRY
	31210	Forestry policy and administrative management
	31220	Forestry development
	31261	Fuelwood/charcoal
	31281	Forestry education/training
	31282	Forestry research
	31291	Forestry services

DAC 5 Code	CRS Code	Purpose Description
313		FISHING
	31310	Fishing policy and administrative management
	31320	Fishery development
	31381	Fishery education/training
	31382	Fishery research
	31391	Fishery services
321		INDUSTRY
	32110	Industrial policy and administrative management
	32120	Industrial development
	32130	SME development
	32140	Cottage industries and handicraft
	32161	Agro-industries
	32162	Forest industries
	32163	Textiles, leather and substitutes
	32164	Chemicals
	32165	Fertilizer plants
	32166	Cement/lime/plaster
	32167	Energy manufacturing
	32168	Pharmaceutical production
	32169	Basic metal industries
	32170	Non-ferrous metal industries
	32171	Engineering
	32172	Transport equipment industry
	32181	Technological research and development
322		MINERAL RESOURCES AND MINING
	32210	Mineral/mining policy and administrative management
	32220	Mineral prospection and exploration
	32261	Coal
	32262	Oil and gas
	32263	Ferrous metals
	32264	Nonferrous metals
	32265	Precious metals/materials
	32266	Industrial minerals
	32267	Fertilizer minerals
	32268	Offshore minerals
323		CONSTRUCTION
	32310	Construction policy and administrative management
331		TRADE
	33110	Trade policy and administrative management
	33120	Wholesale/retail trade
	33130	Export promotion
332		TOURISM
	33210	Tourism policy and administrative management
400		MULTISECTOR/CROSS-CUTTING
410		General environmental protection
	41010	Environmental policy and administrative management

DAC 5 Code	CRS Code	Purpose Description
	41020	Biosphere protection
	41030	Bio-diversity
	41040	Site preservation
	41050	Flood prevention/control
	41081	Environmental education/ training
	41082	Environmental research
420		Women in development
	42010	Women in development
430		Other multisector
	43010	Multisector aid
	43020	Multisector aid for basic social services
	43030	Urban development and management
	43040	Rural development
	43050	Non-agricultural alternative development
	43081	Multisector education/training
500		COMMODITY AID AND GENERAL PROGRAMME ASSISTANCE
510		Structural Adjustment Assistance with World Bank/IMF
	51010	Structural adjustment
520		Developmental food aid/Food security assistance
	52010	Food aid/Food security programmes
530		Other general programme and commodity assistance
	53010	Balance-of-payments support
	53020	Budget support
	53030	Import support (capital goods)
	53040	Import support (commodities)
920		SUPPORT TO NON-GOVERNMENTAL ORGANIZATIONS
	92010	Support to national NGOs
	92020	Support to international NGOs
	92030	Support to local and regional NGOs
998		UNALLOCATED/UNSPECIFIED
	99810	Sectors not specified
	99820	Promotion of development awareness

6. Finally, the proposal for classification of adaptation technologies is shown in table E.6. These classifications are used by the UNFCCC roster of experts.

Table E.5. Classification of adaptation technologies

Coastal zone management	**Natural resources management**
• Coastal engineering	• Conservation management
• Coastal resource management	• Water resource management
• Wetlands management	• Watershed management
• Sea level rise	• Water conservation
	• Water supply systems
Agriculture and fishery	**Forestry**
• Land degradation	• Forest management
• Soil erosion	• Agroforestry

• Salinization • Desertification • Irrigation **Health science** • Public health • Epidemiology • Infectious and tropical diseases **Geography and planning** • Landuse planning • Rural planning • Urban planning • Geographical information systems • Remote sensing • Vegetation cartography **Environmental economics** • Any environmental economics • Energy economics • Resource economics • Conservation economics • Development economics • Finance and investments	• Afforestation • Reforestation • Energy plantations **River base management** • River engineering • River resource management/planning **Human infrastructure** • Industry • Transportation • Cities and human settlements • Financial services and insurance • Sewage treatment systems • Waste management

Annex F

Examples of ESTs

1. For illustrative purposes, two coal-fired electricity generation technologies (pulverized coal - PC and integrated gasification combined-cycle (IGCC)), one gas-fired power plant (gas turbine combined-cycle (GTCC)) and one CO_2 sequestration technology are presented below. The technologies are stored in the EST DB. The source of information was "Greenhouse Gas Emissions from Power Stations", IEA Greenhouse Gas R&D Programme CRE, Stroke Orchard, Cheltenham, Gloucestershire, GL52 4RZ, United Kingdom [11].

Pulverized coal with flue gas desulphurization power plant (PC+FGD)

2. *Description:* the plant is a sea water-cooled, conventional pulverized coal-fired steam plant with limestone-gypsum flue gas desulphurization. The net power output is 500 MW and the fuel is a bituminous coal (figure F.1 shows a schematic of the process).

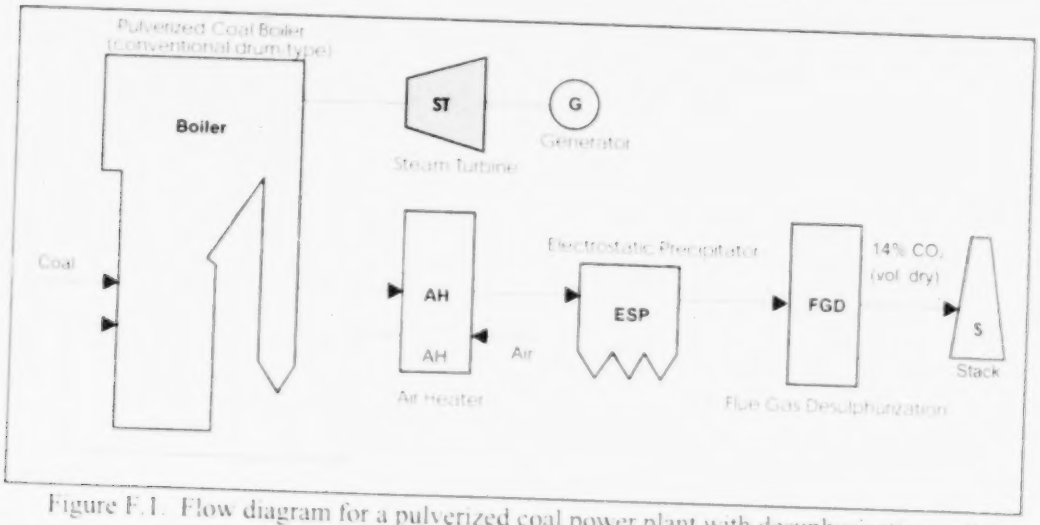


Figure F.1. Flow diagram for a pulverized coal power plant with desuphurization unit

3. A boiler module provides steam for a condensing steam turbogenerator. Flue gas from the boiler module (after particulate separation in electrostatic precipitators) is cooled, scrubbed in a FGD unit, reheated and then sent to the stack. The plant includes all the necessary auxiliary power, water and waste treatment systems. Sea water is used for cooling in the condenser. The boiler is a conventional drumtype, utilizing natural circulation. NO_x control is by combustion measures only.

4. The FGD plant uses the limestone/gypsum process to remove 90% of the sulphur dioxide from the gases exiting the induced draught fans. In the reference plant, the uncontrolled sulphur dioxide concentration in the stack gases is about 1900 mg/Nm^3 (referenced to 6% O_2, dry). This falls to about 190 mg/Nm^3 after 90% removal (table F.2).

Table F.1. Summary of key results for a fuel cost of 2$/GJ (10% DR)

Plant	SO_2 (%)	Size (Mw)	Efficiency (%)	Specific Cost ($/kW)	CO_2 emissions (kg/MWh)	Power cost (mills/kWh)
Subcritical	90	500	40	1060	830	49
Subcritical	95	500	40	1080	830	50
Subcritical	90	250	40	1300	830	59
Supercritical	90	500	43	1060	770	47

5. The balance of plant includes the auxiliary power supply system, the cooling system and water supply, and water treatment and waste water systems. The auxiliary power supply system provides the power to operate the ESPs, the FGD and by feed pumps plus the numerous other motor drives necessary to the running of the plant. Cooling is by a once-through sea water cooling system.

6. *Efficiency:* The estimated plant thermal efficiency is 40% on a net calorific value basis for 90% sulphur dioxide removal. The performance of a notional pulverized coal-fired power station without flue gas desulphurization has also been estimated. Without FGD, plant net output is increased by 11 MW and thermal efficiency is increased by 1%.

7. *Emissions:* Table F.2 shows the estimated specific emission rates of the GHGs, carbon dioxide and nitrous oxide, in g/kWh. Nitrous oxide values are based on 10 ppmv of the gas at 6% oxygen, dry. Most of the carbon dioxide comes from the coal, although about 0.5% is released by the limestone.

Table F.2. Specific emissions of stack gases from the PC+FGD plant

Pollutant	g/kW_h
Carbon dioxide	830
Nitrous oxide	0.06
Sulphur dioxide	0.6
NO_x	2.1
Particulate	0.1

8. It also shows the estimated specific emission rates of the other potential pollutants in the stack gases. The sulphur dioxide emissions correspond to around 50% of the limit specified in the current European Directive.

9. NO_x emissions correspond to the European Directive limit of 650 mg/Nm3 at 6% oxygen, dry. Emissions could be further reduced by using pollution minimum burners, flue gas recirculation, reburning, selective catalytic reduction, selective non-catalytic reduction, or a combination of some of these.

10. The specific emissions of CO_2 and N_2O for a typical current technology supercritical plant are estimated to be 770 and 0.06 g/kWh, respectively. Corresponding estimates for ultra-supercritical plant are 730 and 0.06 g/kWh.

11. *Costs:* The capital cost of the reference plant has been estimated from the plant mass and energy flows; a breakdown is given in table F.3. For 90% sulphur dioxide removal, the specific cost, including contingency land and clearance, is estimated to be $1060/kW.

Tab'e F.3. Capital cost breakdown

Component	$ (million 1991)
Coal reception and storage	24
Coal handling	3
Boiler plant	124
Electrostatic precipitators	24
Steam turbine generator	107
Cooling system	11
Water treatment and waste water plant	7
Electrical distribution	20
Controls and instrumentation	11
FGD plant	56
Miscellaneous (buildings, fire protection, fuel oil system, support systems, mobile equipment, building services)	72
TOTAL	458
Contingency	46
Total plant cost	504
Land, Clearance, etc.	25
Total excluding interest during construction and commissioning	529
Specific investment cost, $/kW	1060

12. The averaged electricity cost for coal prices up to $6/net GJ delivered has been predicted. These are expressed in mills per kWh and are based on 90% sulphur dioxide removal. The contributions to the total electricity cost at 10% discount rate are illustrated in table 4 for a coal price of $2.5/net GJ. Capital and fuel costs dominate. The total electricity cost is about 50 mills/kWh at the coal price given. Of this, about 20 mills/kWh comes from the capital charges and 20 mills/kWh from the fuel cost.

13. Approximate generating costs have been determined for a supercritical plant. The estimated electricity cost saving compared with the reference plant is around 3 to 4% for coal at $2.5/net GJ. Because of the outline nature of the examination, this saving should be regarded as indicative only.

Table F.4. Breakdown of generating costs for 10% DR, 90% SO_2 removal in mills/kWh

Capital	21
Fixed operating	9
Variable operating	1
Fuel ($2.5/net GJ)	22
Total	53

14. *Discussion:* Limestone/gypsum, the most frequently used process to remove SO_2 from PC power station flue gases, does not remove enough SO_2 to be compatible with the amine-based scrubbing processes, commonly proposed to capture carbon dioxide (<30 mg/Nm^3 required). Similarly, the use of modified combustion technology such as low NO_x burners is not able to

reduce the nitrogen oxide content of the flue gas to below about 200 mg/Nm^3. Thus, gas treatment processes aimed at capturing CO_2 need to be considered not in isolation, but as part of the overall gas clean-up process. There may well be an incentive to develop processes which capture all the acid gases, including CO_2.

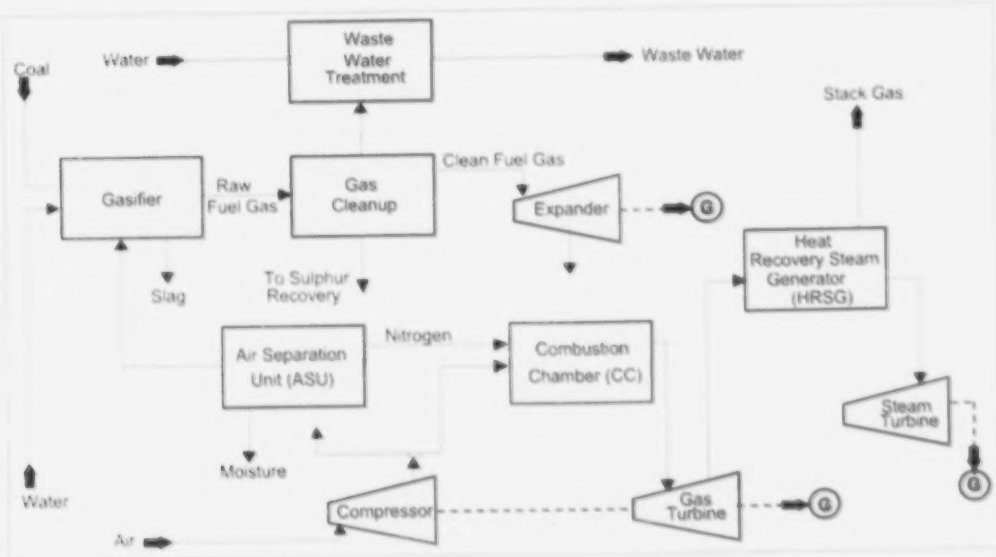
15. Comparative evaluations of the economic penalty for capturing CO_2 should be compared with processes that achieve low levels of sulphur and nitrogen oxides. Process efficiency gains derived from using super critical steam cycles lead to reductions in the order of 7% of CO_2 produced per unit of power generated. The economics appear to be marginally in favour of supercritical power plant when the coal is priced at an international market price. A PC power station with facilities to reduce the emission of CO_2 is likely to be based on the use of supercritical rather than subcritical steam.

Integrated gasification combined-cycle (IGCC)

16. *Description:* This text characterizes the power generation in an IGCC plant, based on results for a standard Texaco gasifier. The power plant is assumed to be sea water cooled and located on the coast in Western Europe. The ambient conditions are 15°C, 1013 bar, relative humidity 60% and the cooling water is available at 15°C. The design fuel is Australian bituminous coal of 0.86% as-received sulphur content from Drayton Mine. Plant emissions are controlled to comply with current EC Directives as minimum. Also, 90% removal of sulphur dioxide (SO_2) is specified.

17. A Texaco-based IGCC power plant with integration of the air separation unit and the gas turbine is shown in figure F.2. The 500 MW IGCC power plant involves two Texaco gasification trains, processing about 4000 t/d of coal, and is integrated with a power block incorporating two Siemens V94.2 gas turbines, one heat recovery steam generation section, one set of steam turbines and an elevated pressure air separation unit (ASU).

Figure F.2. A Texaco-based IGCC power plant.



18. The overall mass balance is summarized in table F.5. A coal slurry is fed to the gasifier with oxygen and raw fuel gas is produced. Ash is removed from the raw coal gas. Fresh water is mixed with condensates in the gas cleaning section and fed to the Venturi scrubber, resulting in waste water.

Table F.5. Mass balance of the Texaco-based IGCC power plant

Input	(kg/s)	Output	(kg/s)
Coal	47	Stack gas	1028
Water (coal slurry)	18	Waste water	26
Air	990	To sulphur recovery	4
Water (venturi scr.)	10	ASU condensates	1
		Ash	5
Total	1065		1065

19. In the Selexol unit, a mixture of H_2S/CO_2 is removed and treated in the sulphur recovery unit. After the gas cleaning section, clean fuel gas flows through the expanders to the gas turbine section. In the air compressor of the gas turbine section, cold air is compressed from which some is sent to the ASU and the bulk is t to the combustion chamber of the gas turbine.

20. The nitrogen product stream of the ASU is admixed for NO_x control and to increase the power output. The total amount of flue gas is 1030 kg/s.

21. The waste heat from the gasifier and the heat recovery stack gas is recovered in the steam bottoming cycle. The net output of the steam turbines is 272 MW.

22. *Efficiency*: an overview of the power balance is given in table F.6, which shows that the net plant efficiency is 42%.

Table F.6. Power balance of the Texaco based IGCC power plant

Input (MW):	
Coal	1206
Output (MW):	
Expander	10
Gas turbine	289
Steam turbine	272
Plant consumption	58
Net output	503
Net efficiency (%)	42

23. As the ASU is responsible for 60% of the ancillary power consumption, the overall power plant efficiency will be sensitive to further improvements in the air separation efficiency. New gas turbine combined-cycles can operate on clean fuel at 50 to 52% (LHV). Today gasification processes operate with gasification efficiencies from 75 to 92% (based on LHV).

24. There are a number of ways of improving the plant's efficiency:

(a) The introduction of a high-temperature gas cleaning system, where all the contaminants in the coal gas coming from the gasifier are removed, can improve the efficiency by 2 to 3% points, compared to an IGCC power plant with a wet gas cleaning system;

(b) The use of advanced gas turbines with higher inlet temperatures and higher pressure ratios. It is generally agreed that IGCC power plants with integrated gas turbine and air separation units will have efficiencies of 38-43% (LHV). Within a matter of years, the technology is expected to have advanced sufficiently to allow the design of coal gasification power plants with even greater efficiencies.

25. An advanced IGCC power plant, incorporating high-temperature gas cleaning and gas turbines with high firing temperatures, could achieve a power generation efficiency of 50% (LHV) within the next 10 to 15 years. This increase in efficiency will consequently result in a lower CO_2 emission i.e. 660 g/kWh. Such an IGCC power plant will also have 50% lower emissions of NO_x and SO_2.

Table F.7. Emissions from a Texaco-based 500 MW, state of the art IGCC power plant

	g/kWh	g/Nm3	t/a
Particulate	<0.006	<0.001	<25
SO_2	0.066	0.012	247
NO_x	0.45/0.25	0.08/0.044	1686/937
CO_2	794	141	2.975×10^6

(NOx figures indicate worst/best scenario).

26. *Emissions:* in an IGCC power plant there are two points where emissions escape to the air:

(c) The stack gas of the waste heat boiler (cooled exhaust gas of the gas turbines) emitting CO_2, SO_2, NO_x and particulate;

(d) The stack gas from the incinerator of the sulphur recovery unit emitting CO_2, SO_2 and NO_x.

27. Table F.7 summarizes the most important emissions to the air from an IGCC plant.

28. Nearly complete (99%) sulphur removal from the coal gas is possible and used in this IGCC power plant. The SO_2 emissions are extremely low and meet current and future EC directives.

29. For this study, the worst-case emissions are well below current EC directives. It is clear that NO_x emissions lower than 25 ppm (15 vol% O2 and dry) are attainable with existing and modern gas turbines. The second source of NO_x emissions to the air is caused by the flue gas coming from the tail gas incinerator of the sulphur recovery unit. This will result in additional NO_x emissions of 20 mg/kWh or 4 mg / (Nm^3 turbine exhaust gas).

30. The emissions of other (volatile) organic compounds, such as polycyclic hydrocarbons, dioxins and furans, are negligible. No significant CO emissions occur in the upper load range of the V94.2 gas turbine.

31. The CO_2 emission is 790 g/kWh. The main CO_2 emission source (97%) in an IGCC power plant is the stack, emitting the cooled exhaust gas of the gas turbines. The remaining 3% is emitted by the acid gas removal plant.

32. Air-blown gasifiers produce a coal gas with a large amount of nitrogen (up to 45 vol%), which will certainly not favour CO_2 recovery. The gas composition is of course dependent on the type of coal gasified.

33. The gasification processes integrated in IGCC power plant systems operate at elevated pressures, favouring the recovery of CO_2 by means of physical absorbents such as Selexol or Purisol and by membranes. Operating these gasifiers at an even higher pressure is technically feasible and will have a positive effect on CO_2 recovery, i.e. a lower efficiency penalty for CO_2 recovery and disposal. The recovered CO_2 can be delivered at higher pressures resulting in lower energy demand for the compression of CO_2 for disposal.

34. To recover CO_2 from coal gas, the IGCC power plant has to be extended with shift reactors and a CO_2 recovery or removal unit. However, the requirements for the shift reduce the overall efficiency of the system.

35. When 90% of the CO_2 in the coal gas is shifted (in two steps and with 50% excess steam), the CO_2 concentration will rise to approximately 34 mol% in the wet coal gas (40% in the dry coal gas). The total investment costs of this shift section will be about $30 million and the annual catalyst costs about $1 million.

Table F.8. Investments of a Texaco based 500 MW_e state of the art IGCC power plant (million US $). Values at 10% DR

Total gasification	205
-Coal treatment	19
Gasifier/sulphur cooler	108
Syngas purifying/sulphur recovery	68
Waste water treatment	10
Total O2-production	88
Total combined-cycle	213
-Gas turbines	86
Waste heat boiler/steam turbines	127
Storage/transport	32
Support systems	37
Common supplies	65
Bare costs (BC)	640
Engineering, procurement, etc. (5% of BC)	32
Capital investment (CI)	672
Fees (2% of CI)	13
Land purchase, site preparation (5% of CI)	34
Contingencies (10% of CI)	67
Total plant costs (TPC)	786
Allowance for funds during construction	177
Total capital requirement (TCR)	963
Total capital requirement ($/kW net)	1910

36. *Costs:* The power production costs shown in table F.8 are based on the rated capacity of the IGCC power plant of 500 MW and a load factor of 85%.

37. Table F.9 summarizes the total costs per annum for the 500 MW_e Texaco-based IGCC power plant.

Table F.9. Power production costs for a 500 MWe, Texaco based IGCC power plant. (Real rate of return at 10%)

Fuel costs (million $/a)	87.4
O & M costs (million $/a)	41.6
Capital costs (million $/a)	90.3
Total costs (million $/a)	219.3
Net production(GW_h/a)	3747.0
Power costs (mills/kWh)	59.0

38. The power production costs are most sensitive to changes in the fuel costs, capital costs and the real rates of return. Investments to improve the efficiency of the IGCC power plant are economically feasible as long as the overall resulting power production costs are equal to or lower than the power production costs of the original base-case IGCC power plant. In the base-case IGCC power plant this will be the case as long as the additional investment costs are lower than 2850 $/kW.

39. The power generation costs of the state of the art IGCC power plant are 49 or 59 mills/kWh respectively at 5 or 10% real rates of return.

40. *Discussion:* There are a number of developments which will result in lower GHG emissions or which will favour recovery and disposal from IGCC power plants. For example:

(e) The use of advanced gas turbines with higher turbine inlet temperatures and higher pressure ratios will increase the power plant efficiency and so decrease the GHG emissions per kWh. Dry, high temperature cleaning of the coal gas will also increase the power plant efficiency.

(f) Higher gasification pressures favour CO_2 recovery by means of physical absorbent or inorganic membranes.

(g) A combination of the shift and the H_2/CO_2 separation in catalytic active membranes can be an attractive alternative.

(h) Coal gasification integrated with high temperature fuel cells will simplify CO_2 recovery, resulting in a lower energy efficiency penalty.

(i) Future work will ensure that assessments of CO_2 removal processes consider fully the implications of varying CO_2 concentrations in a relatively large exhaust gas stream. The shift reaction is an obvious area of interest where the concentration of the CO_2 in the fuel gas can be increased.

(j) Further studies should include the investigation of advanced gas turbines, high temperature gas cleaning and the operation of IGCC at high pressure.

(k) For longer-term study a possible technology combination is IGCC with fuel cells giving overall efficiencies of over 50%.

Natural gas-fired combined-cycle with heat recovery

41. *Description:* The plant uses North Sea natural gas burnt in a modern combined-cycle power station, equipped with two gas turbines, two HSRG and one steam turbine, illustrated in figure F.3. Steam is generated at two pressure levels.

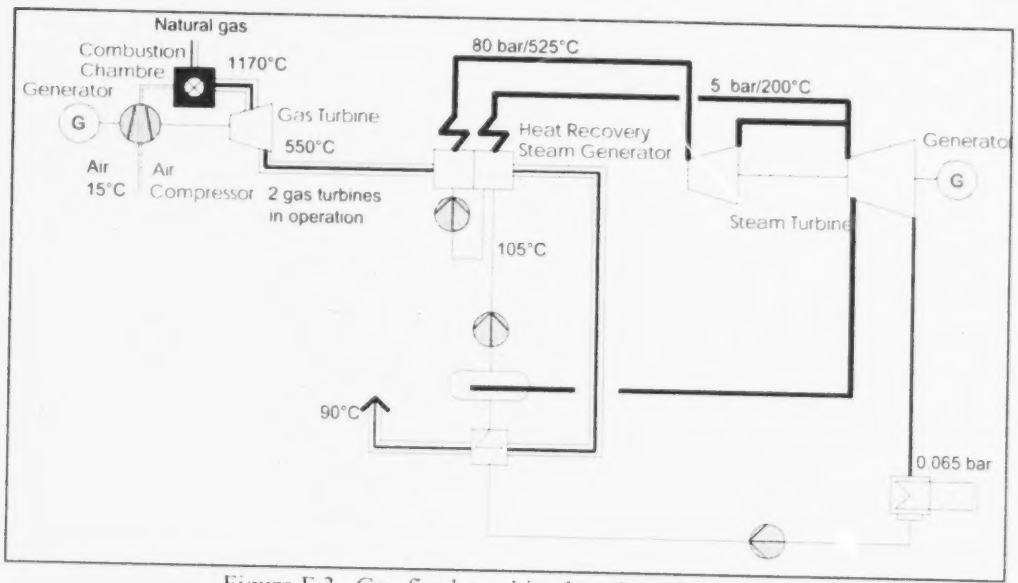


Figure F.3. Gas-fired combined-cycle with heat recovery

42. A combined-cycle is a combination of two or more thermal cycles within a single power plant, where the intention is to increase the efficiency over that of single cycles. Normally the cycles can be termed as "topping" cycle and "bottoming" cycle due to the temperature level at which the cycles operate. Most of the heat is supplied to the "topping" cycle, which operates at rather high temperatures, while the "bottoming" cycle utilizes the heat rejected from the "topping" cycle. The cycles are usually coupled in a heat exchanger. The composition of the fuel gas is given in table F.10.

Table F.10. Fuel gas composition (no clean up) of a typical North Sea "Brent" natural gas

Component	Symbol	Fractions (vol%)
Nitrogen	N_2	0.9
Carbon dioxide	CO_2	0.7
Methane	CH_4	82.0
Ethane	C_2H_6	9.4
Propane	C_3H_8	4.7
Butane	C_4H_{10}	1.6
Pentane	C_5H_{12}+	0.7

43. *Efficiency:* the base line case plant has a design efficiency of 52% (LHV), which is compatible with other published results. The actual operating efficiency of the base-case plant would be in the order of 50%. Typical efficiencies for large plants can be expected to increase to

55% in the near future and ultimate efficiencies of around 60% are conceivable, depending upon gas turbine developments.

44. The figures given in table F.11 are the design performance data. Depending on the type of fuel, a reduction in plant power output of 3-10% and plant efficiency of 2-5% (52% to 49-51%) can be expected. Cleaning of the gas turbine makes it possible to recover 50-80% of these losses.

Table F.11. Plant energy balance (MW)

Gas turbines	294
Steam turbine	177
Plant total - gross	470
Boiler feed pumps	
Cooling water pump	
Auxiliaries	
Plant total - net	465
Fuel LHV input	894
Net efficiency (%)	52

45. *Emissions*: Natural gas usually has a low sulphur content, and therefore the SO_x emissions are very low. On the other hand NO and NO_2 emissions from gas turbines are considered to be a greater problem. There are basically three demonstrated methods of suppressing and reducing NO and NO_2 emissions from gas turbines:

(l) Pre-mix and hybrid burners

(m) Water and steam injection

(n) Selective catalytic reduction.

46. The base-case assumes the use of pre-mix/hybrid burners to achieve a NO_x level of 25 ppmv; steam/water injection is the most widely used method for NO_x reduction and this decreases efficiency by 2-5% with a corresponding increase in electricity costs.

47. Emissions of carbon monoxide (CO) from gas turbines are regarded as a minor environmental problem. The emission level of CO is typically below 10 ppmv (15% O_2, dry) at full load.

48. Emissions of N_2O are in principle following the same trend as CO with respect to the gas turbine load. At full load the emission levels of CO and N_2O are relatively small, but at part load, the emissions are significant. The emission level for N_2O is approximately 1 ppmv (15% O_2, dry). The exhaust gas characterization is given in table F.12.

Table F.12. Exhaust gas characterization

Component	Mole composition % (ppmv)
Nitrogen (N_2)	75.00
Argon (Ar)	0.90
Oxygen (O_2)	13.80
Carbon dioxide (CO_2)	3.44
Water (H_2O)	6.90
Nitrogen oxides as (NO_2)	25.00
Pressure	1.013 bar
Temperature	89°C
Dew point	39.0°C
Molecular weight	28.41 kg/kmole

49. The CO_2 emissions are about 400g/kWh. The high excess air levels necessary for gas-fired turbines result in a low concentration of CO_2 in the exhaust gas and a high mass flow rate per unit of power generated (2 kg/s/MW compared to a value of 1 kg/s/MW for the equivalent coal-fired unit). Processing schemes which increase the concentration of CO_2 in the turbine exhaust have potential.

50. *Costs:* The cost of a turnkey combined-cycle power plant varies from case to case, but the specific cost is in the range 400-680 $/kW. For the present study a specific cost of 600 $/kW is used. In table 4 a typical cost distribution for a turnkey combined-cycle power plant is given which may be typical for the present case where two gas turbines, two HRSGs and one steam turbine are used.

Table F.13. Typical cost distribution for a turnkey combined-cycle power plant (2GTs + 2HRSGs +1ST)

Gas turbine auxiliary equipment	26%
HRSG + piping + auxiliary equipment	17%
Steam turbine + generator + piping + condenser	21%
Electric and supervisory equipment + transformer	12%
Civil engineering	6%
Erection + supervision	18%

51. In table F.14 the total capital investment is converted to cost of electrical power and some operational costs are added, resulting in the power cost before the fuel cost is added.

Table F.14. Cost of electrical power before adding the fuel cost

Real rate of return	10%	(mills/kWh)
Total capital investment converted		10
Taxation and insurance		1
Maintenance		1
Labour cost – administration		1
Power cost (no fuel cost)		15

52. The power cost is in the range 25-45 mills/kWh if a typical fuel cost (natural gas) of 10-18 cents/Sm^3 is included.

53. *Discussion*: The combined-cycle power plant has received an increasing amount of interest in the last decade. The two main reasons for this are the progress which has been made in the development of gas turbines and the focus on environmental aspects of power generation.

54. Features of GTCC include good operating flexibility short installation time; limited fuel, flexibility; low emissions of SO_x, NO_x and CO_2; and suitability for use in cogeneration. In cogeneration, fuel energy utilization may be up to 80-90%, while at the same time electrical power is generated at efficiency above 40%.

55. The main trends in development are:

(o) Towards increased efficiency and power output of the gas turbine;

(p) Towards the use of coal in gas turbines;

(q) Towards attaining lower NO_x emissions levels without water or steam injection (dry low-NO_x combustors);

(r) Towards a more complex steam cycle design in order to improve the utilization of the gas turbine exhaust.

56. Although development of the technology is, to a large extent, concentrated on increasing the inlet temperature to the gas turbine and hence efficiency, there are additional gains to be made by improvements to the steam cycle. In particular, the combination of triple pressure reheat systems with supercritical steam cycles looks attractive.

Carbon dioxide recycle power plant

57. *Description*: This text characterizes power generation in a coal combustion plant fed by oxygen (see figure F.4) and using recycled carbon dioxide as the means of temperature control. The base-case is atmospheric PC combustion in oxygen. It is based on speculative long-term technology rather than existing or medium-term technology

58. From storage, the coal is pulverized and transferred in a mixture of recycled flue gases and oxygen to low NO_x burners. Some of the unburnt coal and ash is removed from the base of the furnace, and the rest of the ash is carried forward with the hot gases and removed in the electrostatic precipitators (ESP). Before reaching the ESPs these hot gases are cooled, and then partially recycled back to the furnace, with any excess being exhausted to the atmosphere.

59. The steam from the superheater tubes goes to the high pressure turbine, where some of the energy in the steam is converted to electricity. The steam from the high pressure turbine is then reheated and passed first to the medium pressure turbine, and then to the low pressure turbine where more electricity is generated. The low-pressure, low-temperature steam from this turbine is then condensed in a sea water condenser. The steam cycle is completed when this condensate is pumped back to the boiler, having first been heated to near boiling point in a series of low and high pressure steam heaters. The volume of flue gases recycled back to the furnace is adjusted in order to maintain boiler conditions. Oxygen from a cryogenic air separation unit is added to maintain normal excess oxygen levels.

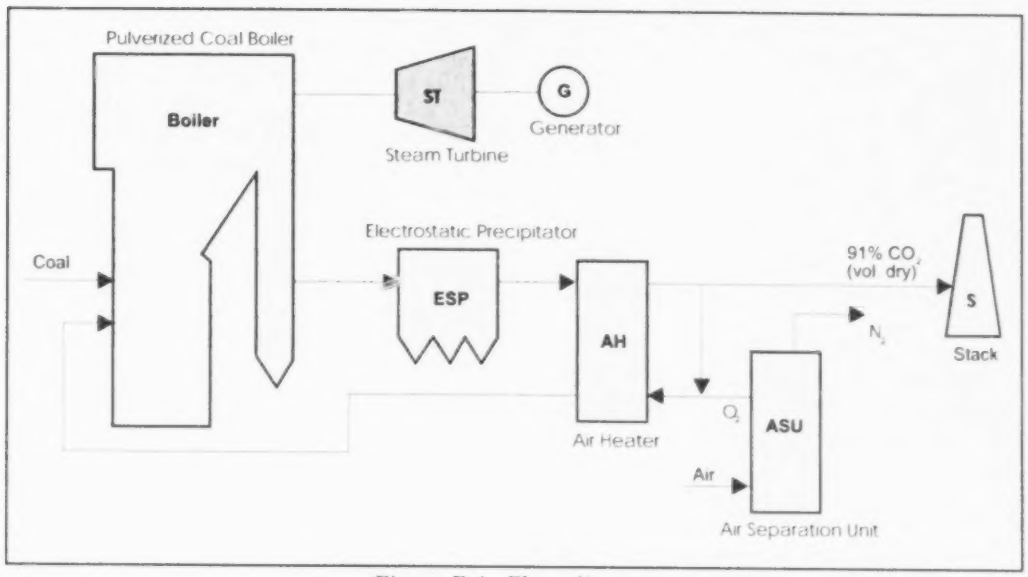


Figure F.4. Flow diagram

60. *Efficiency*: The base-case plant operating a recycled CO_2 system has a design efficiency of 33% (LHV) compared to the base-case (PC + FGD) efficiency of 40% for the study. A study based on a supercritical plant with SCR reports that the adoption of CO_2 recycle reduces an initial plant efficiency of 39% (HHV) to 31% (HHV). It has been calculated that fitting CO_2 recycle to an existing 500 MW unit would reduce the plant efficiency from 38% (LHV) to 27% (LHV). In both cases the CO_2 is produced as a pure liquid suitable for pipeline disposal.

Table F.15. Mass and energy balance results

	Air-fired	**99% O_2/CO_2 fired**
Pressure in combustor	1 Bar Abs.	1 Bar Abs.
Heat input (MW, LHV)	1260	1524
Electricity generated (MW)	522	654
Ancillary consumption:		
O_2 separation (MW)	0	126
Coal/ash systems (MW)	3	3
Fans/sompressors (MW)	3	3
Condensate pumps (MW)	12	15
Cooling water (MW)	6	7
Total ancillary (MW)	22	154
Overall results:		
Net electricity (MW)	500	500
Overall efficiency %	40	33
Emission results:		
CO_2 (g/kWh)	1000	1000
NO_x (g/kWh)	1	1
SO_x (g/kWh)	6	7

61. The results of the converged mass and energy balance calculations are summarized in table F.15 and are given together with the corresponding results for the standard air-fired PC coal-fired combustor.

62. The efficiency of the O_2 fired system is improved due to the recycling of hot flue gases back to the combustion chamber. In the air-fired system these hot gases are used to preheat the combustion air.

63. *Emissions*: Both processes use low NO_x burner technology to minimize NO_x formation, but neither incorporates any system for reducing SO_2 emissions in the flue gas.

64. The CO_2 content of the flue gas has increased from 14 Mol% to 63 Mol%, with the major part of the remaining flue gas being water vapour at 32 Mol% (table F.16). The total flow of flue gases has decreased from 550 kg/s to 180 kg/s, and the high moisture content of the flue gases has increased the flue gas dew point temperature from 50°C to 80°C.

Table F.16. Flue gas analysis

	Air-fired	99% O_2/CO_2
Pressure (Bar Abs)	1.00	1.00
Temperature (°C)	132.00	166.00
Density (kg/m3)	1.00	1.00
Flow rate (kg/s)	552.00	178.00
Dew point (°C)	49.00	79.00
Flue gas composition (Mol%)		
Argon	1.00	0.30
CO_2	14.00	63.00
H_2O	8.00	32.00
HCl	0.01	0.01
N_2O	74.00	0.60
NO_x	0.02	0.07
O_2	3.00	4.50
SO_x	0.07	0.30

65. Subsequent downstream processing of the flue gases, especially if this involves cooling and compression, will mean that most of the SO_x together with some of the CO_2 will be dissolved in the condensed water phase. Special consideration of the construction materials of this downstream processing equipment will therefore be required.

66. Although referred to for convenience as stack gas, following downstream recovery of the CO_2 and condensation of the water, the gases that will actually be vented to the stack are minimal.

67. Although there are high levels of nitrogen and sulphur oxides in the gas, they are not comparable to the results from previous studies because there are no clean-up facilities. It has been suggested that the high levels of NO_x in the recycled gas lead to a reduction in the net quantity of NO_x produced.

68. A beneficial feature of this concept is the small volume of gas that needs to be treated to recover/condition the CO_2. The mass flow rate of purged gas requiring further processing is less

than 0.4 kg/s/MW compared to three times this number for the PC case studied earlier and twice this again for the gas-fired case.

69. *Costs*: The capital and operating cost factors used by the programme are considered to be study estimates. Summaries of these capital costs are given in table F.17.

Table F.17. Summary data from the technical and financial criteria tables used for the base-case analysis

	$ millions
Solids handling (coal and ash)	72
Boiler house	255
Steam and condensate system	55
Steam turbines and generators	213
Cryogenic air separation units	290
Cooling water system	22
Total system cost	907

70. The financial evaluation of this process was performed for three coal prices and two discounted cash flow rates, as shown in table F.18.

Table F.18. Economic evaluation of oxygen fired PC power station at 10% DR

Fuel cost ($/GJ)	2.0	2.5	3.0
Costs in $ millions			
Process capital cost	885.0	885.0	885.0
Utilities capital cost	22.0	22.0	22.0
Total capital cost	907.0	907.0	907.0
Inc. contingency, work cap., fees	1,022.0	1,022.0	1,022.0
Inc. construction & commissioning	1,356.0	1,356.0	1,356.0
Cost of coal & by-products	99.0	123.0	148.0
Operating, maintenance & insurance cost	48.0	48.0	48.0
Income from electricity	339.0	364.0	388.0
Electricity generating cost (mills/kWh)	77.5	83.0	88.5
Pay back period (Years)	15.0	15.0	15.0

71. The capital cost of the process was calculated for three power generation levels, 500 MW, 400 MW and 250 MW, and the break-even electricity generation cost was calculated for a coal price of 2.5 $/GJ and a discounted cash flow rate of 10%. The results are summarized in table F.22. It shows that the break-even electricity generation cost is 83 $/MWh for a plant size of 500 MW.

72. The specific capital cost of 2,040 $/kW is significantly greater than the figures quoted for the other power generation technologies. In this cases, however, the CO_2 is to a large extent ready for disposal, the only further processing needed being dictated by handling and disposal requirements. As this technology is new, comparative specific capital cost figures are not readily available and a prime requirement for any future examination of this technology would be to get a better indication of the costs involved.

Table F.19. Power generation cost according to plant size

Plant size (MW)	500.0	400.0	250.0
Costs $ millions			
Process capital cost	885.0	740.0	476.0
Utilities capital cost	22.0	17.0	11.0
Total capital cost	907.0	757.0	487.0
Inc. contingency, work capital, fees	1,022.0	853.0	546.0
Inc. contr. & commissioning	1,356.0	1,131.0	729.0
Cost of coal & by-products	123.0	99.0	62.0
Operating, maintenance & insurance costs	48.0	40.0	26.0
Income from sale of electricity	364.0	299.0	191.0
Electricity generating cost (mills/kWh)	83.0	85.4	87.2
Pay back period (years)	15.0	15.0	15.0

73. *Discussion:* The advantage of the oxygen-fed PC coal-fired combustor, is that the majority of the system is based on tried and tested technology, and therefore the results are more likely to be reliable and successful. The major areas of uncertainty for O_2 fed PC coal-fired combustion with CO_2 recycle to maintain boiler conditions, are the possible effects of the high concentration of CO_2 and H_2O in the combustion gases on the burner, the boiler, and the superheater tubes. The combustion air feeding the burner has a completely different composition, and this may affect the combustion chemistry and flame stability.

74. CO_2 recycle technology may be more suitable for retrofit situations rather than for new power plants. Including CO_2 liquefaction, IGCC based technology is quoted as having overall efficiencies in the 30-33 % (LHV) region. If O_2/CO_2 recycle in conjunction with supercritical steam plant can reach efficiencies such as this, it could well be attractive for new plants as well as retrofit situations. Not only does the processing route appear significantly simpler, in terms of the number of reaction and combustion systems required, it also has the attraction of being more amenable to integration into the existing power station infrastructure. Although the technology is at an early stage of development, no obvious major technical obstacles to its introduction have been identified.

75. It is evident that the capital investment and power consumption needed to produce oxygen in the ASU will be major factors in any scheme for CO_2 capture and disposal, based on eliminating the nitrogen content of air from the process route. Air separation is a mature technology and although there may be some gains to be made by integrating with IGCC or CO_2 recycle schemes, they are not likely to be of major significance.

76. The question of SOx build up in the recycle system affects boiler materials of construction and requires careful attention, as does the influence of SO_x on final disposal.

Annex G

Sample of numerical data for ESTs

Table G.1. Samples of technical, economic and environmental characteristics (power plants)

Characteristics	Unit	Fossil steam boiler	Gas turbine	PWR
1. Technical				
Output capacity (Rated)	MWe	o	o	o
Output capacity (Net)	MWe	r	r	r
Output capacity (Max)	MWe	r	r	r
Equivalent full power	h/yr	r	r	r
Forced outage	%	r	r	r
Scheduled maintenance	days/yr	r	r	r
Unit operating modes	%			r
Unit fuel inventory	$			r
Enrichment requirements	% U-235			r
Burnup	MWd/kg			r
Net efficiency (LHV)	%	o	o	o
Heat rate - full load	kcal/kWh	r	r	r
Heat rate - average net	kcal/kWh	r	r	r
Heat rate - min. load	kcal/kWh	r	r	r
Plant technical lifetime	yr	o	o	o
Excess air	%	x	x	
Steam pressure	MPa	o	o	o
O_2 removal efficiency	%	o		
Particle removal efficiency	%	o		
NO_x removal efficiency	%	o	o	
CO adsorbent control	%	o	o	
SO_x adsorbent control	%	o	o	
NO_x adsorbent control	%	o		
CO_2 Content in flue gas	% vol CO_2	o	o	
2. Economic				
Net overnight costs	US$/kWe	r	r	r
SO_x domestic fraction	%	r	r	r
Fixed O&M costs	US$/kWe/yr	r	r	r
Variable O&M costs	mills/kWhe	r	r	r
Decommissioning costs	US$/kWhe	o	o	o
Decommissioning duration	yr	o	o	o
Refurbishment costs	US$/kWe	o	o	o
Refurbishment duration	yr	o	o	o
Fuel costs (domestic)	c/kcal	r	r	r
Fuel costs (foreign)	c/kcal	r	r	r
Economic lifetime	yr	r	r	r
Construction period	yr	r	r	r
Interest during construction	%	o	o	o
3. Environmental				
Air				
CO	g/kWh	o	o	
CO	g/kWh	r	r	
NO	g/kWh	o	o	
NO_x	g/kWh	r	r	
SO_x	g/kWh	r	r	
NMVOC	g/kWh	o	o	
HC	g/kWh	o	o	
PP	g/kWh	o	o	

r = required; o = optional; x = not applicable

Table G.2. Sample of a detailed structure for economic characteristics (power plants)

Characteristic	Unit	Abr.	Level
Total capital requirement	US$ kWnet	TCR	1
Net overnight costs	US$ kWe	NOC	2
Total overnight construction costs	US$	TOCC	3
Base costs	US$	BC	4
Land	US$	LND	5
Structures and site facilities	US$	SSF	5
Boiler or NSSS	US$	NBS	5
Dedusting	US$	PART	5
Desulphurization	US$	DSOX	5
Denitrification	US$	DNOX	5
Steam turbine	US$	ST	5
Gas Turbine	US$	GT	5
Water conditioning	US$	WC	5
Electrical engineering	US$	EE	5
Process control technique	US$	PCT	5
Indirect costs	US$	IC	5
Supplementary costs	US$	SC	4
Owner's costs	US$	OC	5
Insurance	US$	INS	5
Spare carts	US$	SPRT	5
Contingency	US$	CTG	5
NOC domestic fraction	%	NOCDF	2
Non-dep. domestic capital cost	US$	COST2L	2
Non-dep. foreign capital cost	US$	COST2F	2
Total O&M costs	mills kWhe	TOM	1
Fixed O&M costs	US$ kWeyr	OMA	2
Variable O&M costs	mills kWhe	OMB	2
Dismantling costs	US$	DCs	2
Dismantling duration	year	DD	2
Refurbishment costs	US$	RC	2
Fuel costs	mills kWhe	FCS	1
Fuel costs (domestic)	c Gcal	FCST	1
Fuel costs (foreign)	c Gcal	FCSTF	1
U-Pu credits	US$ kgHM	CRD	2
Conversion	US$ kgU	CONV	2
Enrichment (separative work)	US$ SWU	ENRI	2
Fabrication	US$ kgU	FABR	2
SF transportation & storage	US$ kgHM	SFTS	2
Reprocessing	US$ kgHM	REP	2
Waste disposal	US$ kgHM	WD	2
Economic lifetime	year	PELIFE	1
Construction period	year	TCON	1
Real discount rate	%	DR	1
Interest during construction	%	IDC	2
Credit for by-product	US$	CBP	2

Annex H

Technology web links classification

1. The number of web sites of organizations specializing in different aspects of the technology transfer is over 300 and is continuing to grow. It is useful, therefore, to provide a structured way of accessing these sites by grouping the links in some categories and by providing a short description for each link. Possible classifications of the sites are given in table H.1.

2. As the UNFCCC takes no responsibility for the content of these external sites a disclaimer will be included. The disclaimer will indicate that the UNFCCC does not endorse or sponsor these sites, is in no way affiliated to the organizations, and does not attest to the accuracy of the information given on these sites.

Table H.1. Classification of web sites by Greentie

A. GHG mitigation technology information
- A.1 Energy supply - Fossil fuel technologies
- A.2 Energy supply - Renewable energy technologies
- A.3 Energy supply - Nuclear technologies
- A.4 Energy supply - Energy transfer technologies
- A.5 Energy end-use - Transportation technologies
- A.6 Energy end-use - Buildings technologies
- A.7 Energy end-use - Industrial technologies
- A.8 Agriculture and forestry practices
- A.9 Other waste techniques

B. GHG mitigation information organizations
- B.1 International
- B.2 National

C. GHG mitigation funding organizations
- C.1 International
- C.2 National

Table H.2. Classification of web sites by CTI

A. Climate change	**B. Energy**
• Modelling sites CHAMMP climate modelling program NCAR community climate model (CCM3) • Carbon Prototype carbon fund • Global aspects Global change The global warming international centre (GWIC) Environmental futures, Inc United States Environmental Protection Agency National Ocean and Atmospheric Administration Global Change Data Information System • Wildlife • Weather	• IEA related • Energy efficiency • Rational use of energy • Renewable energy • Suppliers miscellaneous

• Science • Data & trends • Potential impacts of climate change • Law & policy • Activist organizations • Preventative measures • Publications & articles • Sceptics • Discussion lists • Research bibliographies • Miscellaneous	
C. United Nations & international Government • OECD • Europe • United Nations • Other	**D. Regional** • Asia • Australia • Canada • Europe • Latin America/Caribbean • United States
E. Search tools • The OECD IEA/ETSAP (Energy technology systems analysis programme) • The IEA energy technology R&D statistics database • www.gbt.ch • Register of library catalogues (German) • U.S. Department of Energy information bridge • World Energy Efficiency Association (WEEA) • European Patent Office (EPO) International Institute for Democracy and Electoral Assistance	**F. Associations & foundations** • Prebon Yamane • Renewable energy in SADC - A guide for investors The European Bank for Reconstruction and Development
G. Branches of industry • Steel industry team (office of industrial technologies) • Aluminium industry team (office of industrial technologies) • Cement industry team (office of industrial technologies) • Glass industry team (office of industrial technologies) • Chemicals industry team (office of industrial technologies) • Glass manufacturing industry council (GMIC)	**H. Organizations & non-profit organization** • Environmental enterprises assistance fund • The Natural resources Defence Council • Tellus institute • Enda third world • Public citizen • International Union for Conservation of Nature and Natural Resources • The Royal Institute of International Affairs • United Nations Industrial Development Organization (UNIDO) • The David Suzuki Foundation • International Centre for Environmental Technology Transfer • Forum Vauban, Inc. • Globe International • Greenpeace • New Energy and Industrial Technology Development Organisation • Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) (German Society for Technical Cooperation)

	• CEPI • World Wildlife Fund
I. Miscellaneous • GeoExchange • The National Academy Press • The Worldwatch Institute • The Foundation Joint Implementation Network • European Media Marketing • Environment at Harvard • Tenaga National Research and Development Sdn Bhd (TNRD) • The Third World Network • CDIAC • EII • Institute for Global Environmental Strategies • The Energy and Atmosphere Programme • SPREP South Pacific Regional Environment Programme • World Resources Institute • Alain Charles Publishing • UPVG • INFORSE • The Development Alternatives • GreenOnline com • The GLOBE Foundation of Canada • Spire Corporation • Energy Star® • CICR net • Energy Globe Award 2000 • Resources for the Future • The Business Roundtable • The Federal Energy Technology Centre • Environmental Financial Products, L.L.C. • The International Nuclear Forum • The International Gas Union • Business Council for Sustainable Energy • Science Applications International Corporation • Cantor Fitzgerald's Environmental Brokerage Services • ACEEE • TECO Energy • EEI	**J. Ocean sequestration of CO_2** • Warming Affects Ocean Algae ABC News • United States Department of Energy • IEA Greenhouse Gas R&D Programme - Carbon Dioxide Utilisation • Berkeley Labs - Science Beat • Ocean Carbon Sequestration • NOAA Ocean Carbon Dioxide and Tracer Program • Centre for International Climate and Environmental Research • Christian Science Monitor - Burying World's Extra CO_2 on Ocean Bottom • Online US News - Prescribing a Sea Cruise for Greenhouse Gases • Norwegian Institute for Water Research Online US News - Prescribing a Sea Cruise for Greenhouse Gases • CSIRO Media Release - How Much Greenhouse CO_2 Can the Ocean Absorb? • Berkeley Lab Earth Sciences Division United States Department of Energy Fossil Fuel Techline • Global CO_2 Management and Sequestration Direct Experiments on the Ocean Disposal of Fossil Fuel CO_2 • Simon Fraser University • United States Environmental Protection Agency • Modelling Ocean Biogeochemistry at LLNL • Christian Science Monitor - Turning the ocean into one big soda pop • Office of Biological and Environmental Research - Carbon Management Science • British Government Panel on Sustainable Development – Sequestration of CO_2 • United States House of Representatives – Statement of T. J. Glauthier Deputy Secretary U.S. Department of Energy • Science News Online – Goodbye to a Greenhouse Gas • Climate Engineering • Geological Survey of Norway • United States Department of Energy • United States Department of Energy Fossil Energy Techline
K. Green power marketing and trading • GreenPrices - Green Energy in Europe • Energy for Sustainable Development Ltd • EuroREX • RECS • Competition in Electricity Markets • Directive 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning	

common rules for the internal market in natural gas • Biomass Chart • Draft RECS country-report format • Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity • Automated Power Exchange • Summary Note on Proposed Guidelines on State Aids for Environmental Protection • The Energy Charter Treaty • Basic Commitment for Participants in RECS • Guidelines for the issuing and supervising tasks in the European Renewable Energy Green Certificate System • Working Paper of the European Commission Electricity from renewable energy sources and the internal electricity market • Energy for the Future: renewable sources of energy	

Annex I

CTI searchable categories and fields

a. General a.1 All a.2 Information/education a.3 Publicity and awards a.4 Procurement a.5 Public/private partnerships a.6 Cooperative agreements	**b. Document type** b.1 All b.2 Manuscript b.3 Database b.4 Internet site b.5 Project proposals b.6 Word document b.7 Excel spreadsheet
c. Transformation c.1 All c.2 Refinery c.3 Electricity c.4 Heat and cogeneration	**d. Residential energy efficiency** d.1 All d.2 General d.3 Single family d.4 Code and standards d.5 Multiple family d.6 Other
e. Commercial energy efficiency e.1 All e.2 General e.3 Office e.4 Health services e.5 Hotel e.6 Schools/colleges e.7 Restaurant e.8 Retail e.9 Food stores/supermarkets e.10 Government buildings e.11 Codes and standards e.12 Other	**f. Industrial energy efficiency** f.1 All f.2 General f.3 Food and beverage f.4 Textiles f.5 Lumber and wood f.6 Pulp and paper f.7 Chemicals f.8 Petroleum f.9 Cement f.10 Glass and ceramics f.11 Rubber and plastics f.12 Primary metals f.13 Electrical equipment f.14 Transportation/communications f.15 Automotive f.16 Misc. manufacturing f.17 Mining f.18 Lighting f.19 Motors f.20 Air conditioning f.21 Refrigeration f.22 Waste heat recovery f.23 Space heating f.24 Water heating f.25 Pumps/compressors f.26 Energy management systems f.27 Industrial processes f.28 Codes and standards f.29 Labelling f.30 Demonstration f.31 Rebates f.32 Energy auditing f.33 Energy accounting f.34 ESCOs/performance contracting

	f.35. Standards of performance f.36. Branding f.37. Monitoring and verification
g. Research and development g.1. All g.2. International collaboration g.3. Public g.4. Private g.5. Demonstrations	**h. Transport** h.1. All h.2. Fuels h.3. Efficiency standards h.4. Freight h.5. Traffic management
i. Land use i.1. All i.2. Forestry i.3. Urban planning i.4. Sinks i.5. Bioenergy i.6. Biomass Levels i.7. Planning/zoning i.8. Waste management	**j. Agriculture** j.1. All j.2. Deforestation j.3. Wetlands j.4. Livestock j.5. Biomass Levels j.6. Fertilizers j.7. Fisheries
k. Finance k.1. All k.2. Project finance k.3. Leasing k.4. Multilateral k.5. Subsidies/grants k.6. Export/import k.7. Other	**l. Renewables** l.1. All l.2. Wind l.3. Geothermal l.4. Solar l.5. Biomass l.6. Other
m. Electricity m.1. All m.2. Generation m.3. Coal m.4. Clean coal m.5. Oil m.6. Natural gas m.7. Transmission distribution m.8. Lighting m.9. Heating m.10. Cooking m.11. Marketing m.12. Fuel cells m.13. Compressed natural gas m.14. Naphta m.15. Oil shale m.16. Nuclear	**n. Legal/regulatory** n.1. All n.2. Pricing and tariff reform n.3. Tax incentives/disincentives n.4. Restructuring/privatization n.5. Market transformation
o. UNFCCC o.1. All o.2. UNFCCC o.3. Kyoto Protocol o.4. CDM/JI/AIJ o.5. National communications o.6. Emission inventories o.7. Technology transfer o.8. Capacity-building	**p. Organizations** p.1. All p.2. NAFTA p.3. ADB p.4. World Bank p.5. MIGA p.6. AEDB p.7. IFC p.8. SADC p.9. ASEAN p.10. APEC p.11. OLADE

	p.12 WTO p.13 IEA p.14 OECD p.15 UNESCO p.16 FAO p.17 UNEP p.18 UNDP p.19 Other

q. Region	r. Country			
q.1 All	r212 All	r.1 Afghanistan	r.69 Finland	r.143 New Zealand
q.2 North America		r.2 Albania	r.70 France	r.144 Nicaragua
q.3 South America		r.3 Algeria	r.71 French Guyana	r.145 Niger
q.4 Central America		r.4 Andorra	r.72 French Polynesia	r.146 Nigeria
q.5 Western Europe		r.5 Angola	r.73 Gabon	r.147 Niue
q.6 Eastern Europe		r.6 Anguilla	r.74 The Gambia	r.148 Norway
q.7 Africa		r.7 Antigua and Barbuda	r.75 Georgia	r.149 Oman
q.8 South Asia		r.8 Argentina	r.76 Germany	r.150 Pakistan
q.9 West Asia		r.9 Armenia	r.77 Ghana	r.151 Palau
q.10 East Asia		r.10 Aruba	r.78 Gibraltar	r.152 Panama
q.11 Southeast Asia		r.11 Atlantic Ocean	r.79 Greece	r.153 Papua New Guinea
q.12 Central Asia		r.12 Australia	r.80 Greenland	r.154 Paraguay
q.13 Middle East		r.13 Austria	r.81 Grenada	r.155
q.14 Other Islands		r.14 Azerbaijan	r.82 Guadeloupe	r.156 Philippines
		r.15 Bahamas	r.83 Guam	r.157 Poland
		r.16 Bahrain	r.84 Guatemala	r.158 Portugal
		r.17 Bangladesh	r.85 Guinea	r.159 Puerto Rico
		r.18 Barbados	r.86 Guinea-Bissau	r.160 Qatar
		r.19 Belarus	r.87 Guyana	r.161 Romania
		r.20 Belgium	r.88 Haiti	r.162 Russia
		r.21 Belize	r.89 Honduras	r.163 Rwanda
		r.22 Benin	r.90 Hong Kong	r.164 Saint Kitts and Nevis
		r.23 Bermuda	r.91 Hungary	r.165 Saint Lucia
		r.24 Bhutan	r.92 Iceland	r.166 Saint Vincent and the Grenadines
		r.25 Bolivia	r.93 India	r.167 San Marino
		r.26 Bosnia and Herzegovina	r.94 Indonesia	r.168 Saudi Arabia
		r.27 Botswana	r.95 Iran	r.169 Senegal
		r.28 Brazil	r.96 Iraq	r.170 Seychelles
		r.29 British Virgin Islands	r.97 Ireland	r.171 Sierra Leone
		r.30 Brunei	r.98 Israel	r.172 Singapore
		r.31 Bulgaria	r.99 Italy	r.173 Slovakia
		r.32 Burkina Faso	r.100 Jamaica	r.174 Slovenia
		r.33 Burma	r.101 Japan	r.175 Solomon Islands
		r.34 Burundi	r.102 Jordan	r.176 Somalia
		r.35 Cambodia	r.103 Kazakhstan	r.177 South Africa
		r.36 Cameroon	r.104 Kenya	r.178 Spain
		r.37 Canada	r.105 Kiribati	r.179 Sri Lanka
		r.38 Cape Verde	r.106 North Korea	r.180 Sudan
		r.39 Cayman Islands	r.107 South Korea	r.181 Suriname
		r.40 Central African Republic	r.108 Kuwait	r.182 Swaziland
		r.41 Chad	r.109 Kyrgyzstan	r.183 Sweden
		r.42 Chile	r.110 Laos	r.184 Switzerland
		r.43 People's Republic of China	r.111 Latvia	r.185 Syria
		r.44 Chinese Taipei	r.112 Lebanon	r.186 Taiwan
		r.45 Colombia	r.113 Lesotho	r.187 Tajikistan
		r.46 Comoros	r.114 Liberia	r.188 Tanzania
		r.47 Democratic Republic of the Congo	r.115 Libya	r.189 Thailand
		r.48 Republic of the Congo	r.116 Lithuania	r.190 Togo
		r.49 Cook Islands	r.117 Luxembourg	r.191 Tonga
			r.118 Macao	r.192 Trinidad and Tobago
			r.119 FYR of Macedonia	r.193 Tunisia
			r.120 Madagascar	r.194 Turkey
			r.121 Malawi	r.195 Turkmenistan
			r.122 Malaysia	r.196 Tuvalu
			r.123 Maldives	
			r.124 Mali	

	r.50. Costa Rica r.51. Cote d'Ivoire r.52. Croatia r.53. Cuba r.54. Cyprus r.55. Check Republic r.56. Denmark r.57. Djibouti r.58. Dominica r.59. Dominican Republic r.60. Ecuador r.61. Egypt r.62. El Salvador r.63. Equatorial Guinea r.64. Eritrea r.65. Estonia r.66. Ethiopia r.67. Faroe Islands r.68. Fiji	r.125. Malta r.126. Marshall Islands r.127. Martinique r.128. Mauritania r.129. Mauritius r.130. Mexico r.131. Federated States of Micronesia r.132. Midway Islands r.133. Moldova r.134. Monaco r.135. Mongolia r.136. Morocco r.137. Mozambique r.138. Namibia r.139. Nauru r.140. Nepal r.141. Netherlands r.142. Netherlands Antilles	r.197. Uganda r.198. Ukraine r.199. United Arab Emirates r.200. United Kingdom of Great Britain and Northern Ireland r.201. United States of America r.202. Uruguay r.203. Uzbekistan r.204. Vanuatu r.205. Venezuela r.206. Vietnam r.207. Yemen r.208. Yugoslavia r.209. Zaire r.210. Zambia r.211. Zimbabwe

Annex J

CADDET searchable categories and fields

Table J.1. CADDET classification and searchable categories

1. Geographic target area	2. Product services
Any geographic area North America Latin America & Caribbean Western Europe Eastern & Southern Europe Africa Former Soviet Republic China Japan Other Asia Australasia	Any product or service Project management Consultancy Engineering Training & education Research development Resources Equipment – machinery Plants Databank Financing Reports – publications Components Software
3. Technology/sub-technology	4. Sector/subsector
Energy supply end-use Any technology Fossil fuel technology Any fossil fuel technology Atmospheric fluidized bed combustion Coal beneficiation Coal-water mixtures Combined-cycle Combustion turbines Diesel cogeneration Fuel cells Industrial cogeneration Gas oil-fired steam units Integrated gasification combined-cycle Intercooled steam injected gas turbine Pressurised fluidized bed combustion Pulverised coal-fired power plant Slagging combustors Any oil & natural gas technology Reduced venting & flaring of gas during production Improved compressor operations Improved leak detection Low-emission technologies & practices Any coal mining technology Enhanced gob well recovery Pre-mining degasification Integrated recovery Renewable Energy Technology Any Renewable Energy Technology Biomass-Fired Power Generation Flat-Plate Photovoltaics	Any sector Sector by industry Any industry Agriculture, hunting & forestry Agriculture Crops, market gardening & horticulture Cereals & other crops Vegetables & horticulture Fruit, nuts, beverage & spice crops Farming of animals Cattle & dairy Other animals, swine & poultry Mixed farming Other agriculture Forestry Fishing Fishing Mining & quarrying Mining & quarrying Coal, lignite & peat Hard coal Lignite Peat Crude petrol, natural gas & oil Crude petrol & natural gas Oil & gas Uranium & thorium ores Metal ores Iron ores Other non-ferrous metal ores Other mining & quarrying

- Geothermal electric
- Municipal solid waste mass burn
- Palletised biomass combustion
- Biogas by anaerobic digestion
- Small-scale hydro
- Solar ponds
- Solar thermal electric technologies
- Parabolic trough
- Central receiver
- Parabolic dish stirling engine
- Wind energy conversion systems
- Tidal energy
- Ocean wave energy
- Landfills: gas recovery & utilization techniques

Nuclear technology
- Any nuclear technology
- Light water reactors
- Heavy water reactors
- Liquid metal fast reactors
- Gas-cooled reactors

Energy transfer technology
- Any energy transfer technology
- Efficient electrical transformers
- Electric transmission & distribution systems
- Thermal energy storage systems
- High voltage direct-current transmission

Transportation technology
- Any transportation technology
- Advanced signalization
- Battery electric vehicles
- Compressed natural gas vehicles
- Continuously variable transmission
- Direct-injection diesel engines
- Efficient jet aircraft
- Efficient tyres
- Ethanol vehicles
- Fuel-cell electric vehicles
- Two-stroke spark ignition engines
- Urban transit systems

Buildings technology
- Any buildings technology
- Adjustable speed electronic motor drives
- Advanced insulation: gas filled panels
- Compact fluorescent lights
- Electronic ballasts
- Efficient electric motors
- Efficient refrigerators
- Energy management systems
- Glazing technologies
- Daylight control
- Insulation

Manufacturing
- Manufacturing
  - Food products & beverages
  - Tobacco products
  - Textiles
  - Wearing apparel, dressing & dyeing of fur
  - Tanning dressing of leather
  - Wood, products of wood & cork
  - Paper & paper products
  - Publishing, print & reproduction
  - Coke, petrol products & nuclear fuel
  - Chemicals & chemical products
  - Rubber & plastics products
  - Other non-metal mineral products
  - Basic metals
  - Fabricated metal products
  - Machinery & equipment
  - Office, accounting & computer machinery
  - Electric motors, generators & transformers
  - Radio, Television & communications equipment
  - Medical, precision & optical instruments
  - Motor vehicles, trailers & semi-trailers
  - Other transport equipment
  - Furniture & other
  - Recycling
  - Metal waste & scrap
  - Non-metal waste & scrap

Electricity, gas & water supply
- Electricity, gas & water supply
  - Electricity, gas, steam & hot water supply
  - Production, collection & distrib. of electricity
  - Manufacture of gas; distribution of gas
  - Steam & hot water supply

Construction
- Construction
  - Building of constructions, civil engineering

Transport, storage and communications
- Transport, storage and communications
  - Land transport
  - Railways
  - Other land transport
  - Scheduled passenger land transport
  - Non-scheduled passenger land transport
  - Freight transport by road
  - Water transport
  - Air transport

Financial intermediation
- Financial intermediation

- Solar control
- Switchable
- Heat pump water heaters
- High-albedo materials
- Landscaping
- Lighting controls
- Room air conditioners (window-type)
- Solar domestic water heaters
- Efficient cooking stoves

Industrial technology
- Any industrial technology
- Anaerobic biological treatment of liquid waste
- Biofiltration of gases
- Cement particle high-efficiency air classifiers
- Ceramic recuperators
- Continuous pulp digesters
- Continuous steel casters
- Distillation control systems
- Electric motors variable speed drives - industrial
- Gas membrane separators
- Heat exchange enhancement techniques
- High efficiency welding power supply
- Mechanical dewatering
- Metal parts cleaning
- Pinch technology
- Pipe cross reactors
- Plating waste concentrators
- Pulse combustion boilers
- Textile dyeing vacuum system

Agriculture & forestry practices
- Any agriculture & forestry practices
- Reduction nitrogen fertilizer & animal manure
- Reduction tillage & agriculture soils
- Reforestation afforestation & prevention of deforestation
- Increasing efficiency intensity of forest management
- Substitution of fossil fuels with sustainably-grown fuelwood
- Increasing agroforestry endeavours
- Livestock technologies
- Improved nutrition mechanical & chemical feed processing
- Improved nutrition strategic supplementation
- Production enhancing agents
- Manure: covered lagoons
- Manure: small-scale digesters
- Manure: large-scale digesters

Other waste techniques
- Any other waste techniques
- Landfills: reducing landfilling of waste
- Waste water treatment

Real estate, business activities
- Real estate, business activities

Public administration & defence
- Public administration & defence

Education
- Education

Health & social work
- Health & social work

Other community & social activities
- Other community & social activities

Private households
- Private households

Extra-territorial organizations
- Extra-territorial organizations

Wholesale and retail trade
- Wholesale and retail trade

Hotels and restaurants
- Hotels and restaurants

Annex K

Full technology chain GHG emissions: a simplified life cycle analysis

1. IT TOOLS may use a simplified version of the process analysis technique to perform the assessment of full chains GHGs emissions. Process analysis is a microanalysis in which complex systems are divided into well-defined process steps. Figure K.1 illustrates a technology (power plant) as a process that needs various inputs and, apart from its main output (electricity), produces various impacts on the environment. In life cycle analysis (LCA) these inputs and outputs are usually referred to as "products".

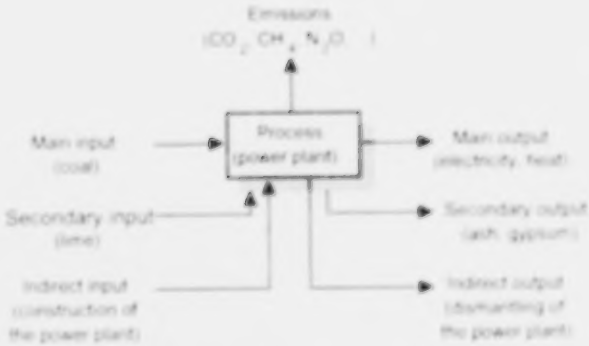


Figure K.1. Process representation of a power plant

2. Since the input of a process is an output from another process, a chain of processes can be assembled by linking these inputs and outputs. The process chain representation of a coal-fired power plant is illustrated in figure K.2.

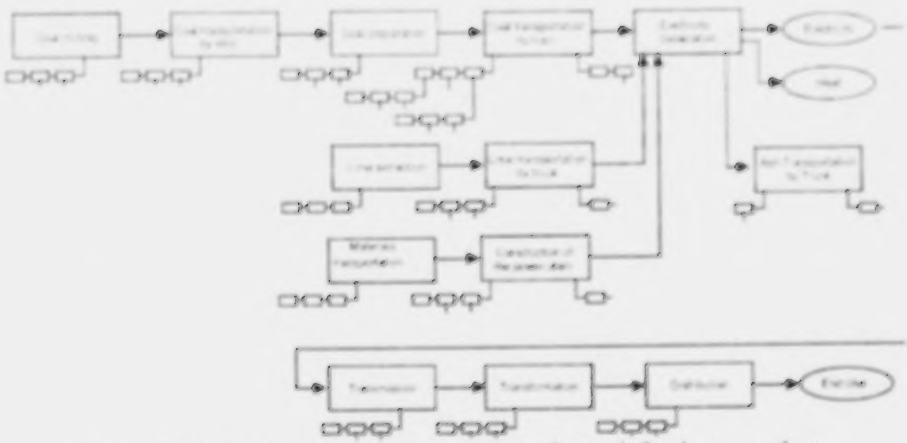


Figure K.2. Process chain representation of a coal-fired power plant

3. Although a process chain usually has a defined end (e.g., one kWh of electricity produced or delivered), it does not have a clear beginning, because each process in the chain needs inputs

delivered by other processes. This means that it is necessary to stop somewhere within the upstream part of the process chain and to leave the remaining links untreated.

4. In TT:TOOLS the secondary and other level processes, e.g., the production of materials used for manufacturing components of an energy facility itself, are taken into account to a limited extent. The results of LCA studies carried out for different technologies are used to identify the situations where significant modifications of GHG emissions occur due to secondary emissions.

5. Data on materials and energy requirements can be stored in the TT:DATABASES. In the process of assessing a technology chain these emission factors data, stored in the materials and energy sources auxiliary databases, are used to calculate the indirect (gray) emissions. This is a simplification as TT:TOOLS will not contain any capabilities to allow for assessment of the emission factors associated with the production of materials used in construction, operation and decommissioning of the technology chain's facilities.

6. The simplified approach is illustrated in figure K.3. The figure indicates how direct and indirect emissions are calculated for a general step in the technology chain. It also shows that for multiple outputs steps, such as crude oil refineries, emission allocation criteria by each product have to be used.

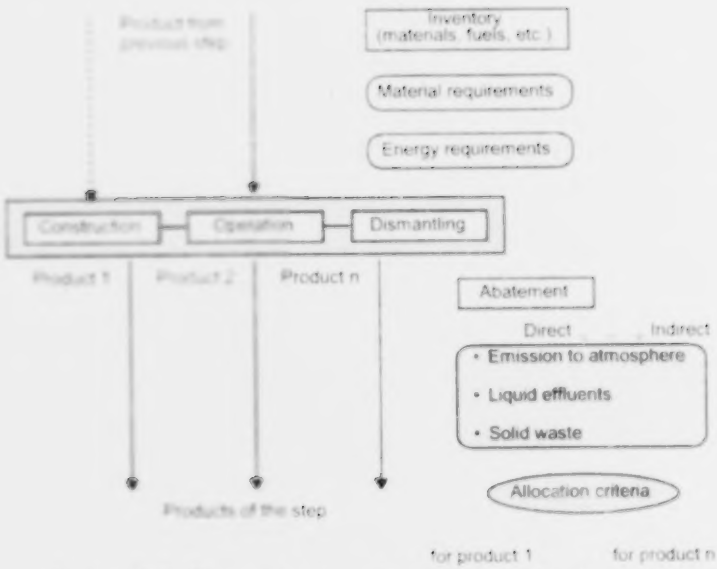


Figure K.3. Representation of a step in a technology chain

7. The method proposed has the advantage of simplicity and may be used to estimate GHG emissions from customized technology chains. For more information on this method see [12].

Annex L

Java-based web application solution

1. One modern option for creating web applications is based on using the Java application environment. The main advantage of this solution is that it is computer platform independent due to the use of a special compilation technique, which produces what is known as byte-code. The byte-code can then be run in a Java Virtual machine, which converts the byte code to a native code on any of the main operating systems.

2. The last version of the Java application environment, called Java Enterprise Edition (J2EE), meets the needs of web developments because it provides (see figure L.1):

(s) Rich integration with a web server via Servlets, which provide objects representing the elements of an HTTP request and response;

(t) Built-in support for sessions, both in Servlets and in EJBs;

(u) The use of the EJBs to mirror the user interaction with data by providing automatic session and transaction support to EJBs operating in an EJB server;

(v) Entity EJBs to represent data as an object;

(w) Seamless integration with the Java data Access API;

(x) Flexible template-based output using JSP and XML.

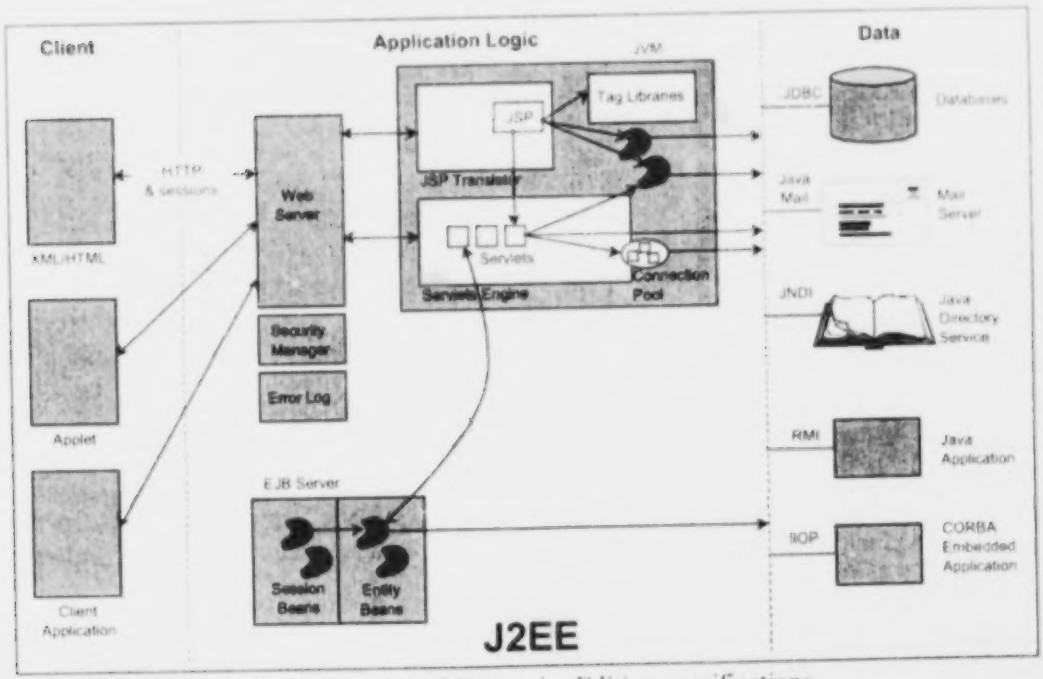


Figure L.1. Java 2 Enterprise Edition specifications

3. Based on this technology, JavaServer Pages (JSP) will have to be developed to create dynamic HTML pages containing data from the IT DATABASEs. The pages, developed using special TAGs from the TAG library, will be automatically translated in Java Servlets by the JSP Translator and will make use of the Java Beans incorporating the application logic. The access to the databases will be made through the use of JDBC drivers. The application can be further integrated with other Java technologies such as Java Mail, JNDI, Remote Method Invocation (RMI) and IIOP.

Annex M

Case studies

Coal power plants in China [7]

1. *Summary:* A recent example of innovative financing of a clean coal technology (CCT) in a developing country is the Huaneng Power Project in China. In this case, the CCT manufacturer worked proactively together with export credit agencies (ECAs) and commercial banks to arrange financing, for the benefit of all stakeholders. In this example, the ECAs' contributions were a vital catalyst for the sourcing of funds for the utility to develop its power stations. This highlights the importance of ECAs, and the need for manufacturers to be proactive in arranging finance.

2. *Background:* In 1997, Huaneng Power International Inc. (HPI), a Chinese utility and a subsidiary of the Ministry of Electric Power (MOEP), financed three new power stations from funds raised by share issues on the international stock markets and by using export credit finance for the procurement of western equipment. From the CCT manufacturer's perspective, the transaction was a typical sale to an 'on balance sheet' purchase by a utility company in a foreign market. Because of the country risk for this market, the CCT manufacturer and the commercial banks required the involvement of ECAs.

3. *Approach:* HPI had a charter from MOEP to procure first-class boiler and turbine equipment from western suppliers. HPI financed its power station development from funds raised by share issues on the international stock markets and by using export credit finance for the procurement of western equipment. The share issues resulted in 25% of the company being owned by international investors. Three new power 700MW power stations were built at Dandong, Dalian and Fuzhou. The western equipment was supplied by Mitsui Babcock Energy Limited (MBEL), Westinghouse and Siemens. MBEL supplied the boiler equipment and Westinghouse and Siemens supplied the steam turbine equipment. The boilers are fitted with 24 low NOx burners, a CCT at the commercially available stage. These burners are rated at 51.6 MW th and NOx is guaranteed at 300 ppm (6% O2 dry) over a range of coals.

4. To finance the western power station equipment, buyer credit facilities were arranged by the manufacturers. To achieve this, the manufacturers approached commercial banks and ECAs. The buyer credit was in the form of commercial bank loans for HPI, provided a consortium of banks. Société Generale and Barclays Bank plc led the lending group of five major banks in these contracts. To enable these commercial banks to make these loans available, export credit backing was required. This was arranged with the ECAs from the manufacturers' countries: ECGD from the UK and EXIM bank from the USA. (ECGD) acted as loan guarantor to Barclays, and Société Generale and EXIM bank provided loans.

5. The export credit financing for the western equipment can be summarised as follows:

	ECGD	EXIM
Dandong	US$ 81 million USD	US$ 158 million USD
Dalian	US$ 84 million USD	US$ 184 million USD
Fuzhou	US$ 92 million USD	US$ 47 million USD

6. In addition, for the Fuzhou project, KfW, a German ECA, supported Siemens in turbine financing.

7. *Impacts*: The low-NOx burners are designed to fire a range of high ash, highly volatile coals. There are also wide-scale plans to retrofit existing boilers with low-NOx burners. There is a reduction of over 60% in NOx emission levels compared to conventional burners. Emissions of NOx can typically be reduced from 430-450 g/GJ to 170 g/GJ.

8. *Lessons learned*: This example illustrates typical 'on balance sheet' financing for a CCT and demonstrates the importance of ECAs in export credit financing. The need for manufacturers to be proactive in arranging finance is clearly demonstrated.

9. *Bibliography*: IEA OECD, 1999: Cleaner Coal Technologies-Financing. Brochure prepared by ETSU for the United Kingdom Department of Trade and Industry on behalf of the IEA Committee on Energy Research and Technology.

Contact

Roshan Kamall
Location 1124
Department of Trade and Industry
Victoria Street
London SW1H 0ET
Fax +44 207 828 7969
E-mail: roskan.kamal@hend.dti.gov.uk

Annex N

International Development Markup Language

1. The international development markup language (IDML), is an initiative led by the World Bank and other international organizations, formed to discuss the possibility of a markup language for the international development community. IDML may become a data exchange standard for information that is specific to international development, making it much easier to share information with regional offices, partner agencies and with the public. It will also be easier to find and manage information about who is doing what, and where.

Table V.1.2. Example of data coverage and structure for international development projects (activities) in IDML

- activities
  - activity
    - id_part
      - activity_id
      - funding_org
    - desc_part
      - title
        - lang="cdata"
        - "pcdata"
      - translated_title
        - lang="cdata"
        - "pcdata"
      - country_region
      - type_of_activity
      - terms_assist
      - status
      - sector
        - source="cdata"
        - "pcdata"
      - cofunding_org
        - cofunding_org_id
        - cofunding_org_activity_id
      - executing_org
        - org_name_acronym
        - country
        - contact
          - contact_name
          - contact_email
          - contact_phone_number
          - contact_postal_address
      - funding_source
      - start_date
      - end_date
      - contact
      - budget
        - total_amount
        - budget_by_year
        - country
        - contact
          - contact_name
          - contact_email
          - contact_phone_number
          - contact_postal_address
      - funding_source
      - start_date
      - end_date
      - contact
      - budget
        - total_amount
        - budget_by_year
      - person_involved
        - contact
          - contact_name
          - contact_email
          - contact_phone_number
          - contact_postal_address
        - affiliation
        - notes_on_role
      - macro_desc
      - local_desc
      - notes
      - abstract
      - related_docs
        - title
        - author
        - source
        - full_text_urn
        - publication_year
        - availability
    - admin_part
      - record_date
        - "pcdata"
      - reporting_org
        - "pcdata"

2. An example of data coverage and structure for international development projects (XML format) is given in table VI.2. The Document Type Definition (DTD), which defines the building blocks of IDML documents and is used to validate XML data, is shown in table VI.3.

3. The data describing an IDML activity is divided into three parts: identification, description and administration. The description part contains most of the data such as activity title, country or region, type, terms of assistance, status and sector. The above proposal does not cover some UNFCCC-specific data such as technology classification and project elements. This structure will be extended, therefore, to cover additional data elements.

Table V.2.3. Development Gateway IDML DTD version 0.29

- The Data Type Definition document contains four layers: elements, attributes, entities and notations.
- The financial data include amounts and currency. However, the exchange rate and or reference year are also needed to facilitate conversions from one currency to another.
- Some information such as the activity title, description and notes can be provided in different languages. In this case the language will be indicated.

Annex O

Technology transfer web sites and clearing houses

1. There are many web sites, which provide information relating to the transfer of climate-friendly technologies. The prototype information system facilitates your access to over four hundreds such external web sites (see section X.C of this document). Some examples of such sites are given below.

2. In cooperation with UNEP, GEF has developed a Project Tracking and Mapping System, which enables project information searches by key project parameters. Further enhancements are being developed that will make more project information available and facilitate more detailed searches and analysis. The Operational Report on GEF Projects, a directory that is compiled twice a year, contains the same information in non-searchable, text form and is available for downloading. The prototype's projects search engine is accessing this site to collect information on climate change related projects.

3. The OECD DAC Creditor Reporting-System (CRS) is an activity based information system comprising data on development assistance by members of the OECD Development Assistance Committee to developing and transition countries. The World Bank co-sponsored the creation of this system, and has full access to its data; however, all data collection and treatment is carried out by the DAC Secretariat. A subset of the CRS consists of individual grant and loan commitments to developing countries and CEECs/NIS (between 6000-30,000 transactions a year) submitted by the 23 DAC Members and multilateral institutions. The CRS was established with the aim of supplying "participants with a regular flow of data on indebtedness and capital flows". The CRS is now a major source of information on the sectoral and geographical distribution, as well as the terms and conditions of official development assistance. The search engine is accessing a backup database (data only for 1998). It is designed to respond to the needs of aid agencies in the area of country and sector programming and analysis. Data presented are unique, comparable and consistent with DAC's statistics' definitions and methodologies. CRS data are collected annually and updated on a monthly basis.

4. The International Energy Agency (IEA) is offering a wide range of on-line decision support tools primarily to member countries[29]:

(y) Greentie is an international information network of that distributes details of suppliers whose technologies help to reduce greenhouse gas emissions. Greentie also provides information on leading international organizations and IEA programs whose R&D and information activities centre on clean energy technologies. The Greentie Directory database contains details of almost 8,000 technology suppliers and information organizations from all over the world.

(z) IEA's Centre for the Analysis and Dissemination of Demonstrated Energy Technologies - CADDET collects, analyses and disseminates information on demonstration

[29] The search engine is accessing Greentie and Caddett

projects in energy efficient and renewable energy technologies. Working within the framework of IEA, CADDET's objective is to provide impartial information about proven technologies to help accelerate their adoption in the market place.

(aa) The IEA Greenhouse Gas R&D Programme is an international collaboration which aims to identify and evaluate technologies for reducing emissions of greenhouse gases arising from use of fossil fuels, disseminate the results of these studies and identify targets for research, development and demonstration and promote the appropriate work.

5. The Global Development Gateway (GDG) of the World Bank, a portal web site on development issues, from which users can access information, resources, and tools, and into which they can contribute their own knowledge and experience, the Gateway creates a common platform for shared material, dialogue, and problem-solving that is easy to access and navigate through. This will enable those in the development field to share information, easily communicate, and build communities of practice around significant challenges from the grassroots up. GDG is one of the key actors in promoting information sharing using aML.

6. Cleaner Production Germany (CPG) is a gateway to comprehensive information about the capabilities of German environmental technologies. Extensive information about national and international support and promotion tools and contacts in the field of technology transfer are available as well. The gateway thus facilitates establishing contact between German and foreign agents of environmental technologies to prepare the ground for joint ventures and business relations. Cleaner Production Germany is also the representative for German companies and institutions abroad as well as of other multiplicators, acting as a well-founded information source to present and convey German environmental competencies. Cleaner Production Germany was established on behalf of the Federal Office for Environment. Numerous partners form the fields of environmental protection, economy, and development work participate in generating contents for this Internet gateway. The search engine is accessing this site to collect information on international development projects and German technologies.

7. MAESTRO, developed by UNEP International Environmental Technology Centre (IETC), is a database, which contains information on a full range of environmental technologies, institutions and information sources including air and water pollution, environmental management, human settlements, recycling toxic substances, solid waste, waste water, water augmentation and more. All maESTro users (individuals, organisations and companies) can browse, insert and modify their own data at their own location through web, e-mail, and/or mail (floppy diskettes for those without Internet access). The new data entered by maESTro users is first sent to UNEP/IETC for verification. The data will be added to maESTro after verification and globally disseminated to maESTro users.

8. China's Centre for Environmentally Sound Technology Transfer (CESTT), which aims to promote the transfer and adoption EST by forming bridges between policy makers, technology suppliers, technology developers, financial institutions, and Chinese industry, in particular small and medium-sized enterprises (SMEs).

A. Glossary of terms

Technology transfer

Adaptation - Adjustment in natural or human systems, in response to actual or expected climatic stimuli or their effects, which moderates human activity or exploits beneficial opportunities.

Barriers - Factors that prevent or impede the transfer of technologies or practices.

Capacity-building - Increase number of skilled personnel and improve technical and institutional capacity.

Climate-friendly - Actions conducive to mitigating climate change.

Emission standard - A level of emissions that by law may not be exceeded.

Environmentally sound technologies - Technologies which protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they are substitutes, and which are comparable with nationally determined socio-economic, cultural and environmental priorities. In this document "environmentally sound" implies mitigation and adaptation technologies. The term includes hard and soft technologies.

Global warming potential - The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations.

Official development assistance - Flows to developing countries and multilateral institutions provided by official agencies, including state and local governments, each transaction of which (1) is administered with the promotion of the economic development and welfare of developing countries as its main objective, and (2) is concessional in character, with a grant element of at least 25 per cent.

Stakeholders - Actors such as governments, private sector entities, financial institutions, NGOs and research/education institutions involved in a technology transfer process.

Technology - A piece of equipment, a technique, practical knowledge or skills for performing a particular activity.

Technology transfer - The broad set of processes covering the exchange of knowledge, money and goods amongst different stakeholders that leads to the spread of technology for adapting to and mitigating climate change. In an attempt to use the broadest and most inclusive concept possible, the document uses the word 'transfer' to encompass both diffusion of technologies and cooperation across and within countries.

Vulnerability - The degree to which a system is susceptible to, and unable to cope with, injury or harm.

Information technology

Active Server Pages - A server side technique, developed by Microsoft, used to generate dynamic HTML pages. It uses mainly VisualBasic as scripting language and is supported only by Microsoft's Internet servers (IIS and personal web server) under the MS Windows operating system. More recently it was replaced by ASP+, also known as web forms (file extension aspx).

Apache - The most used web server on the Internet. It is available under many operating systems, including Unix, Linux, Solaris and Windows, and is an open source product.

Aplet - A program, written in the Java programming language, which runs in a web browser. When you use a Java technology-enabled browser to view a page that contains an applet, the applet's code is transferred to your system and executed by the browser's Java Virtual Machine (JVM).

CORBA - An open standard-based solution for distributed computing. The Object Management Group (OBM), an industry consortium, developed the specifications for CORBA and specified the Internet InterORB Protocol (IIOP), the standard communication protocol between Object Request Brokers.

Java - A platform-independent object-oriented programming language developed by Sun Microsystems.

JavaBeans - A software component that has been designed to be reusable in a variety of different environments.

JDBC - A universal connector to databases

JSP - JavaServer Pages™ (JSP™) technology offers a simple way to create dynamic web pages that are both platform-independent and server-independent, giving you more freedom through Java™ technology's "Write Once, Run Anywhere™" capability. JSP technology separates content generation from presentation and takes advantage of reusable tags and objects, simplifying the maintenance of web applications. JSP technology provides the scripting ability needed to create simple interactive web pages, or it scales to support complex web sites that are fully integrated with enterprise class applications.

MS Access - A relational desktop database management system produced by Microsoft.

MS SQL Server - A relational database management server produced by Microsoft.

Paradox - A relational desktop database management system produced by Borland and Corel (similar to MS Access).

Servlet - Small, platform-independent, Java programs that can be used to extend the functionality of a web server.

Tomcat - A web server which provides world-class implementation of the Java Servlet 2.2 and JavaServer Pages 1.1 Specifications. This implementation may be used in the Apache web server as well as in other web servers and development tools.

XML - XML is a new markup standard for networked documents, a set of custom tags similar to those used in HTML. It is expected that XML will become the lingua franca for exchanging data over the Internet. While implementation of the new "meta-language" is in full swing by software developers, there is currently a window of opportunity for various professional groups (medical practitioners, chemists, engineers, etc.) to use XML to define their own sector-specific markup languages. IDML is an example of such an initiative for storing and exchanging data on international development projects and activities.

B. Acronyms and Abbreviations

Development and Transfer of Technology

ACEE	American Council for Energy-Efficient Economy
ADB	Asian Development Bank
AH	air heater
ASEAN	Association of Southeast Asia Nations
ASU	air separation unit
APEC	United States the Asia-Pacific Economic Cooperation
CADDET	Centre for Analysis and Dissemination of Demonstrated Energy Technologies
CDM	clean development mechanism
CIDA	Canadian International Development Agency
CEPI	Confederation of European Paper Indistries
CIS	contact information system (UNFCCC)
COP	Conference of the Parties
CRF	common reporting format
CRS	Creditor Reporting System
CTI	Climate Technology Initiative
DAC	Development Assistance Committee of the Organisation for Economic Co-operation and Development
DoE	United States Department of Energy
DR	discount rate
EBS	Environmental Brokerage Services
ECA	export credit agency
ECGD	United Kingdom Export Credits Guarantee Department
EEI	Edison Electric Institute
EIA	United States Energy Information Administration
EBRD	European Bank fro Reconstruction and Development
EPA	United States Environmental Protection Agency
EST	Environmentally Sound Technologies
ESP	Electrostatic Precipitator
EU	European Union
FGD	flue gas desulphurization

Gateway	Development Gateway (World Bank)
GCDIS	Global Change Data & Information System
GEF	Global Environmental Facility
GHG	green house gas
GJ	gigajoule
GMIC	Glass Manufacturing Industry Council
Greentie	Greenhouse Gas Technology Information Exchange
GT	generic technology
GTCC	Gas Turbine Combined-cycle
GTZ	German Agency for Technical Cooperation
HPI	Huaneng Power International Inc.
HRSG	heat recovery steam generator
IEA	International Energy Agency
IETC	International Environmental Technology Centre (UNEP)
IPCC	Intergovernmental Panel on Climate Change
IEAGHG	IEA Greenhouse Gas R&D Programme
IFC	International Finance Corporation
IGCC	integrated gasification combined-cycle
IGO	International Organizations
IGU	International Gas Union
INTIB	Industrial and Technological Information Bank
ISIC	International Standard Industrial Classification
LCA	life cycle analysis
LLNL	Lawrence Livermore National Laboratory
LHV	lower heating value
maESTro	searchable EST database developed by UNEP/IETC
MIGA	Multilateral Investment Guarantee Agency
MDB	multilateral development banks
MOEP	China Ministry of Electric Power
NAFTA	North American Free Trade Agreement
NEDO	New Energy and Industrial Technology Development Organization
NGO	Non Governmental Organizations

NOAA	National Oceanic and Atmospheric Administration
NREL	United States National Renewable Energy Laboratory
O&M	operation and maintenance
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OLADE	La Organización Latinoamericana de Energia
PC	pulverized coal
PTI	Project Technology Inventory
R&D	research and development
RT	reference technology
ROE	roster of experts
SAIC	Science Applications International Corporation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SBI	Subsidiary Body for Implementation
SCR	selective catalytic reduction
ST	steam turbine
TECO	TECO Energy
TCAPP	Technology Cooperation Agreement Pilot Project
TNRD	Tenaga National Research and Development
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
URL	Uniform Resource Locator, an address of a web-page or any other file on the Internet
USAID	United States Agency for International Development
WEEA	World Energy Efficiency Association
WEC	World Energy Council
WHO	World Health Organization
WMO	World Meteorological Organization
WTO	World Trade Organization

Information Technology

ASP	active server pages
ASP+	active server pages plus, also known as web forms
DBMS	Database Management System
Cocoon	pure Java publishing framework that relies on new W3C technologies (such as DOM, XML, and XSL) to provide web content.
CORBA	Common Object Request Broker
DTD	document type definition
IDML	International Development Markup Language
JDBC	Java Data Base Connection (drivers)
JEE2	Java Enterprise Edition version 2
JINI	Java Naming Directory Interface
JSP	JavaServer Pages
RDBMS	Relational Database Management System
SOAP	simple object access protocol
RMI	Remote Method Invocation
XLS	Extensible Stylesheet Language
XSLT	language for transforming XML documents
XML	eXtensible Markup Language

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